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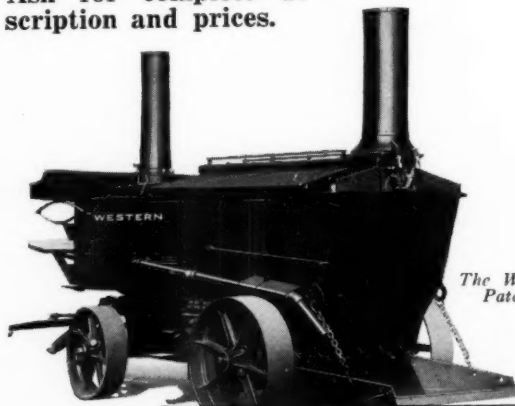
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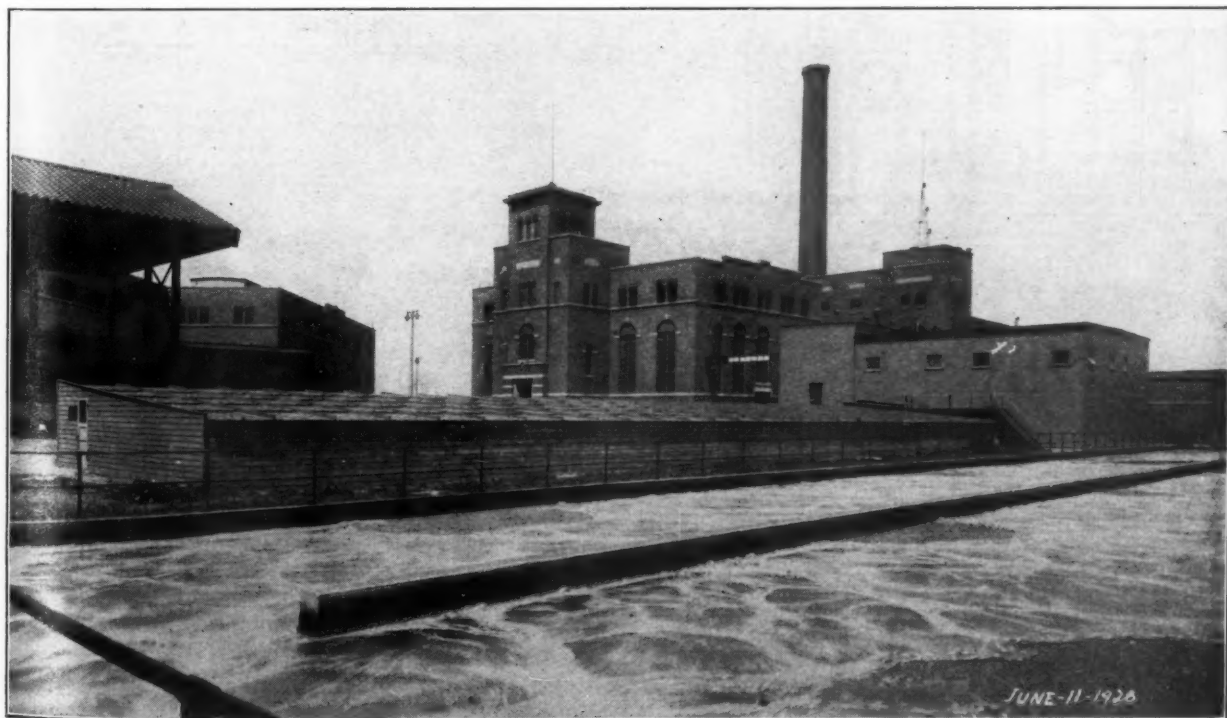
Digesting Sewage Screenings at Milwaukee

Milwaukee, Wisconsin, spent a large sum of money in investigating sewage treatment processes by means of a large-scale experimental plant, prior to the final adoption and development of the activated sludge plant which has been in operation for the past three years. Study, investigation and experiments have been continued with a view to working out additional features of the plant and improving upon the present features. Among the investigations has been one on the best method of disposing of the screenings. The plans finally worked out and the plant constructed for a full-scale study of the subject were described by Darwin Wadsworth Townsend in a paper before the American Society for Municipal Improvements, which was supplemented by another paper by Dr. Willem Rudolfs dealing with the theoretical side of the matter; Dr. Rudolfs having been retained by the Milwaukee Sewerage Commission as its consulting chemist on screenings digestion during the experimental and demonstration period. These papers describe the plant and method of operation in too great detail to permit of their

being published in full in *PUBLIC WORKS*, but we have endeavored to present in the following article the more important features of these papers as completely as the space available permits.

Mr. Townsend is assistant to the commission's chief engineer, Robert Cramer, and has been associated with the Milwaukee sewage disposal problems throughout the entire fourteen years of the sewerage commission's existence. The research program is being carried out by Henry Heisig, plant research chemist, under the supervision of John Arthur Wilson, for some years past consulting chemist to the commission.

The Milwaukee sewage treatment plant, of which the activated sludge process is the principal feature, has now been operating for about three years. The plant is located on the lake front, largely on made ground, and there are no facilities readily accessible for burying the screenings, of which about 1,400 cubic feet per day must be provided for, and the



GLASS-ROOFED BUILDING ENCLOSING SLUDGE BEDS
Aeration tank in immediate foreground. Plant buildings in background

most economical and inodorous method of disposing of them has been made a matter of considerable study.

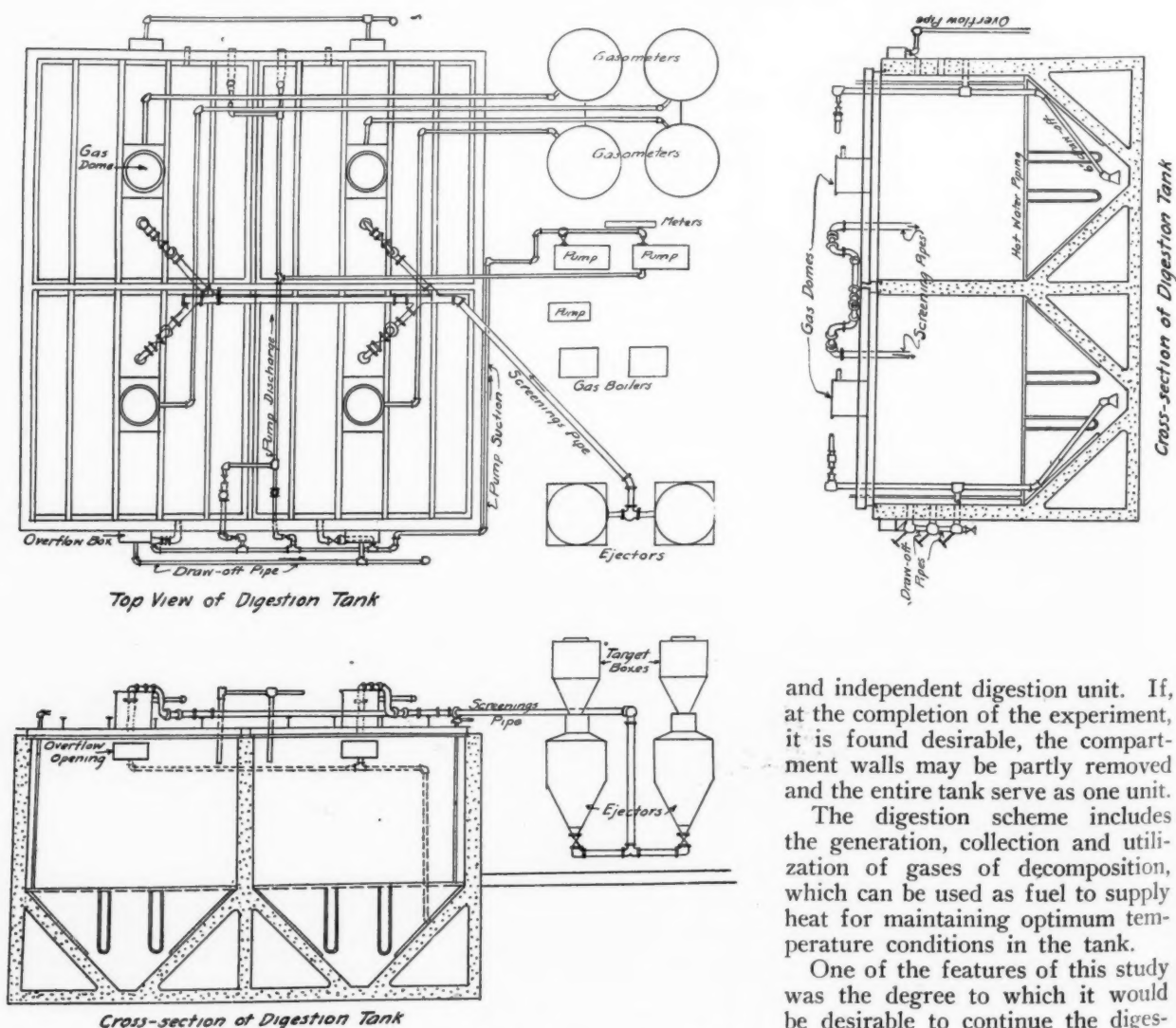
During the summer of 1927, with a view to adopting digestion for this purpose, an extended survey was made of the largest separate sludge digestion plants in the country and a study of the results of small-scale experiments carried on in the laboratory of the sewerage commission. Existing plants, however, dealt with sewage sludge and not sewage screenings, and it did not necessarily follow that the process would be equally applicable to the latter, because of the coarser, less uniform, and widely varying character of the materials contained in sewage screenings. It was therefore decided to make a large-scale experimental test of the process, and a plant for this purpose has been constructed and it is just going into operation. This plant was designed to serve the dual purpose of a partial permanent operating unit as well as an experimental unit, and contains a number of new and rather unique features which will be tested under actual operating conditions.

Of the 1,400 cubic feet of screenings from the

flow of 100,000,000 gallons per day of sewage, approximately 14% is retained on two sets of coarse bar screens with 2-inch clear openings, and the remaining 86% upon drum screens having $\frac{3}{8}$ " by 2" slots. The moisture content of an average composite sample is about 92% by weight.

Previous experiments of the sewerage staff have indicated very definitely the desirability of providing ample capacity for test units and also a sufficient number of units so that tests of similar character may be conducted in parallel; the latter because if repeat or check test runs are found necessary, the material may have changed appreciably in character and composition between the original and the following test.

It was decided that four digestion tanks, each capable of retaining one twelfth (116 cubic feet) of the estimated daily screenings production upon an assumed 30-day digestion period, should be provided. For economic reasons and for the purpose of segregation to facilitate the carrying on of experiments, one comparatively large reinforced concrete unit was constructed of cellular type, each of the four cells or compartments being an individual



TOP VIEW AND CROSS-SECTIONS OF MILWAUKEE DIGESTION TANK

and independent digestion unit. If, at the completion of the experiment, it is found desirable, the compartment walls may be partly removed and the entire tank serve as one unit. The digestion scheme includes the generation, collection and utilization of gases of decomposition, which can be used as fuel to supply heat for maintaining optimum temperature conditions in the tank.

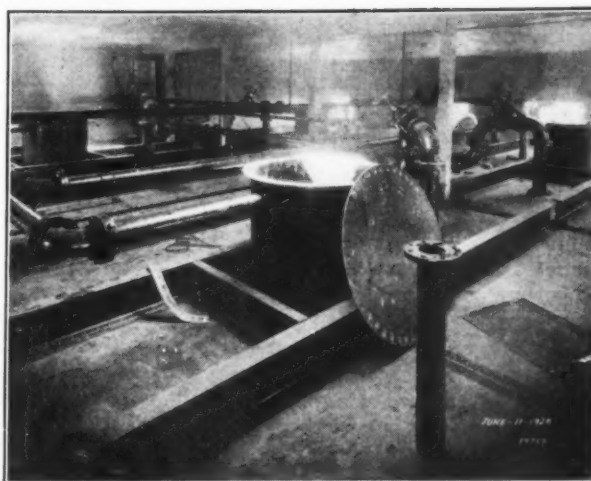
One of the features of this study was the degree to which it would be desirable to continue the digestion process.

In this connection there were studied three major problems; first, the effect of combining digested screenings (digested to a degree to be determined) with the waste activated sludge from the purification process, for the purpose of using it in the production of "Milorganite" (the fertilizer being made and sold by this plant), either by mixing it directly with the waste sludge or, second, by returning digested screenings to the raw sewage ahead of the drum screens, and allowing that portion that passes through the screens to pass entirely through the process with the sewage, while the screened out matters would be returned to the screening tank for further digestion. The third alternative was drying upon ordinary sludge beds, glass covered; the air-dried sludge to be disposed of as found most convenient. For studying the third alternative, 15 sludge bed compartments were constructed in the ordinary way, enclosed and covered with glass, each sludge bed being estimated capable of receiving one day's supply of digested screenings resulting from an assumed schedule for charging the tanks with approximately 465 cubic feet of fresh screenings each day.

GENERAL DESCRIPTION OF PLANT

Each of the four digestion compartments is 18 feet square, with a hopper bottom having floor slopes of 45° and a depth of 8 feet 3 inches, the vertical side walls having a height of 12 feet 6 inches to the top of the wall. These are covered with tops of $\frac{3}{16}$ -inch steel plates with welded butt joints, the plates being close riveted to the lower flanges of supporting I-beams which extend across the top of the deck. The ends of these I-beams and edges of the deck plates rest upon 8-inch channels embedded two inches in the top of the concrete side walls.

On top of and riveted to the deck plate at the center of each tank is a gas dome three feet in

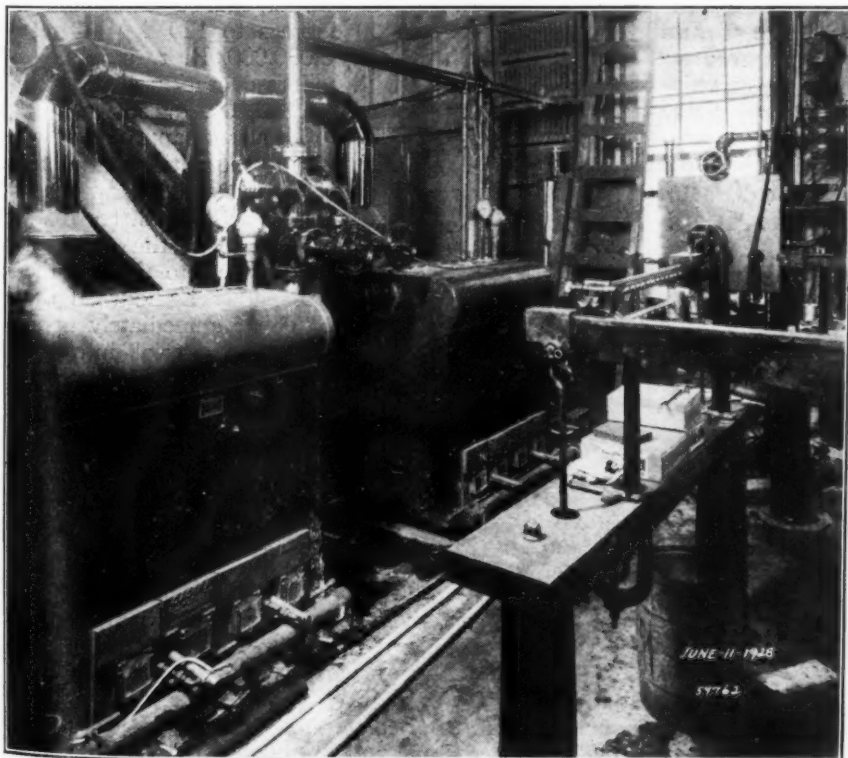


DIGESTION TANK DECK, SHOWING GAS DOMES, GAS PIPES AND SCREENINGS PIPES

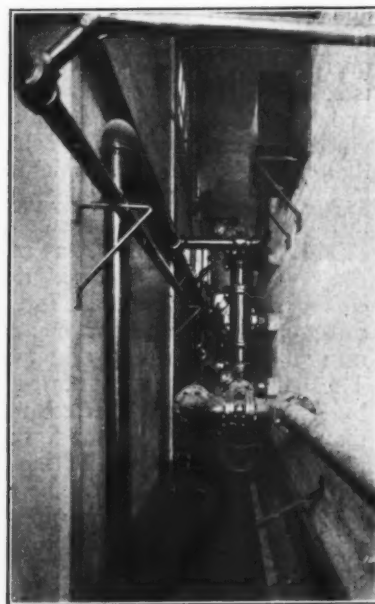
diameter and three feet high, made of $\frac{3}{16}$ -inch plates welded at the vertical butt joints. Each dome is sealed on top with a $\frac{1}{4}$ -inch steel plate cover bolted to the upper flange of the dome, with an asbestos sheet packing gasket, to secure a gas-tight joint.

Each compartment is equipped with an over-flow opening 5 inches high and 3 feet long, located in the outside wall of the tank with the top of the opening 11 inches below the top of the wall. Attached to the outside of the wall and covering this opening is a water-sealed overflow box trap 3 feet long, 1 foot wide and 18 inches deep, connected to a drain, the purpose of which is to permit an automatic overflow when the depth of liquor in the tank has reached or exceeded the allowable maximum limit, without permitting gas to escape during the overflow. It also

serves as an emergency safety valve to permit the



GAS BURNERS; SCREENINGS SCALES IN FOREGROUND



DRAW-OFF PIPES, IN CENTER; OVERFLOW CONTROL BOX AT TOP; OPEN SLUDGE TROUGH AT BOTTOM

escape of gas should the gas pressure become greater than desirable. The normal gas pressure probably will not exceed that due to a 2-inch water head, and the tank depth is designed to stand a pressure equivalent to a 6-inch water head; and the depth of water in the over-flow trap can be so regulated as to blow out at any pressure between 2-inches and 6-inches of water.

The steep slope of the hopper bottoms, 45 degrees, is due to the past experience and experiments of Mr. Townsend with the slow and uncertain flow characteristics of sewage screenings.

Drawing off Sludge. Provision is made for drawing off digested screenings from each tank compartment either from the bottom of the hopper or from points along the outside wall, two feet, four feet and six feet from the top of the tank wall. Drawing from the hopper is effected through a 6-inch wrought iron pipe which follows the angle of the hopper bottom and then the vertical side and passes through the steel deck, terminating in a tee, the top of which is equipped with a removable plug for flushing or rodding. The side draw-offs are pipes built into the wall ending flush with the inner face, each provided with a valve. The sludge can be drawn off by the hydrostatic head of the liquor in the tank, as is the ordinary practice. If it is desired to draw sludge from one tank to another, or to mix it by drawing from the bottom or middle of a tank and returning into the top of the same tank, this can be done by means of a motor-driven pump connected to the tee in the hopper draw-off previously mentioned and to each of the side outlets. Material drawn off by gravity can be discharged directly into an open trough which extends into and through the glass-covered sludge beds. It is the intention at first to employ the recirculation of the sludge as a substitute for mechanical agitation.

GAS COLLECTION

Every conceivable precaution was taken to prevent the escape of gas at any time, in order that accurate information may be obtained concerning the quantity and quality of gas. It will be unnecessary at any time throughout the process to vent to the atmosphere any portion of the closed system in which gas is contained. A gasometer 5 ft. 6 in. inside diameter and 8 ft. 6 in. high, of 10-gauge sheet iron, is provided for each digestion compartment. Each of these will equalize and maintain any predetermined gas pressure up to the point where the displacement in the tank compartment caused by the introduction of additional screenings, has reached 200 cubic feet. As the maximum assumed daily charge for each compartment is 116 cubic feet, nearly 100% excess capacity is provided for fluctuations or changes in rate of screenings fed to the tank.

The gas domes are connected with the gasometers by 4-inch pipes, connected to the dome approximately 6 inches below the top and at the gasometers through the top plates of the water-seal tanks and terminating just inside of the gas displacement compartment. While 4-inch pipe is theoretically much larger than is necessary for the quantity of gas anticipated, it was used in order to obtain a more nearly constant gas pressure in the line at all times. Two-inch pipes connect the gasometer to the gas meter, leaving the gasometer at a point 2 feet distant

from the gas inlet. A 980 cu. ft. per hr. standard gas company meter is provided for each tank.

HEATING EQUIPMENT

Two Mueller 49W "Gas Era" gas-fired hot water boilers and automatic control mechanism were installed, each with a guaranteed output of about 320,000 B. t. u. per hour based upon commercial city gas characteristics. These heat the digestion tank through a closed circulating hot water system, the hot water being circulated by a 75 g.p.m. motor-driven hot water pump equipped with a thermostat control for automatic starting and shut-off.

The hot water circulates through about 170 lineal feet of 1½-inch copper pipe in each compartment, arranged upon the four sides of the sloping bottom in the form of U's made up of straight pipe and return bends, each of the eight U's in a compartment extending in a downward direction from the intersection of the slopes with the vertical walls to a point approximately two-thirds of the total slope distance therefrom; the total radiating surface in each compartment being about 75 square feet. The amount of hot water applied to the different compartments may be varied by controlling the flow of hot water by hand valves. It was planned to start both hot water boilers operating with city gas when the plant was first placed in service, to bring the initial charge of material to the optimum temperature; after which this temperature will be obtained by one boiler using city gas, until such time as the gas produced by screenings digestion will suffice for the purpose. It is anticipated that the gas burner jets may need to be enlarged to satisfactorily use the digestion gas.

Heat loss computation indicates that the total hourly loss by radiation through the tank walls and roof and the withdrawal of digested screenings, amounts to approximately 110,000 B. t. u. To raise the temperature of the initial charge in the four compartments from 40 degrees to 120 degrees requires approximately 112,000,000 B. t. u., which indicates that with both boilers operating at an output rate of 640,000 minus 110,000, or 530,000 B. t. u. per hour, a total of 210 hours or approximately 9 days will be required to bring the initial charge up to temperature. After this, there will be available from one boiler approximately 210,000 B. t. u. per hour for raising the temperature of the assumed daily charger of crushed screenings to that of the mass; this requiring approximately 12 hours if the further assumption be made that immediately upon the introduction of cold, fresh material into the compartment, it at once becomes intimately mixed with the heated material. However, the fresh material is added at the top of each compartment, furthest removed from the hot water pipes, and therefore the rise in temperature will not be immediate.

The plant provides a considerable factor of safety. It is surmised that the assumed digestion period of 30 days may be substantially decreased, and the heat requirements to maintain a temperature of 80° proportionately increased. For example, if a 15-day digestion period is found feasible, one heater can possibly accommodate the required 40 degree temperature rise; while, on the other hand, if a period equal to or longer than the assumed 30 days is found necessary and the quality of gas produced

is below that anticipated, the capacity provided would seem to offer only a reasonable degree of safety.

In addition to the above method of heat control, the tank, which is located almost entirely above ground, is enclosed with a substantial weather-proof building, and in this structure, on the outside of the tank walls, are a sufficient number of steam radiators to maintain the room temperature above 75 degrees when the outside temperatures are below zero. It will thus be possible for experimental purposes to control the temperature surrounding the tank so as to establish and maintain any desired heat differential between the heated tank contents and the air around the tanks.

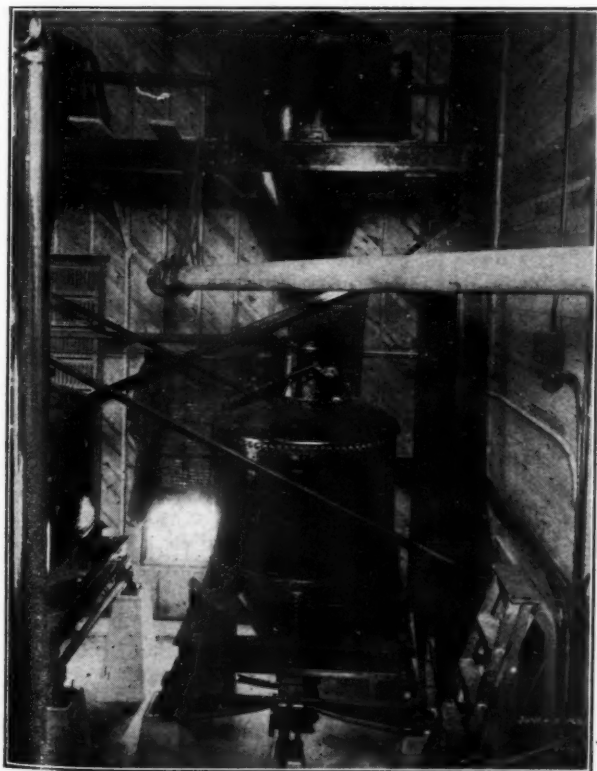
CHARGING SCREENINGS INTO TANKS

Mr. Townsend says that probably no other feature of the plant was developed with more infinite care than the semi-automatic means of supplying the tank compartments with raw screenings. In preparing the plans, the designers were aided by experience in conveying screenings during the three years of the plant's operation. Two pneumatic ejectors had been used, located in the building containing the fine screens, for automatically removing the screenings from the screen house to a storage point several hundred feet distant. A branch line was taken off from the line originally constructed for removing the screenings, so that by closing a valve in the main line and opening one in the branch, screenings can be diverted to the digestion plant, where they enter one of the two pneumatic charging ejectors of one hundred cubic feet displacement, both hand and electrically controlled. These ejectors are mounted upon Fairbanks-Morse beam scales for the purpose of

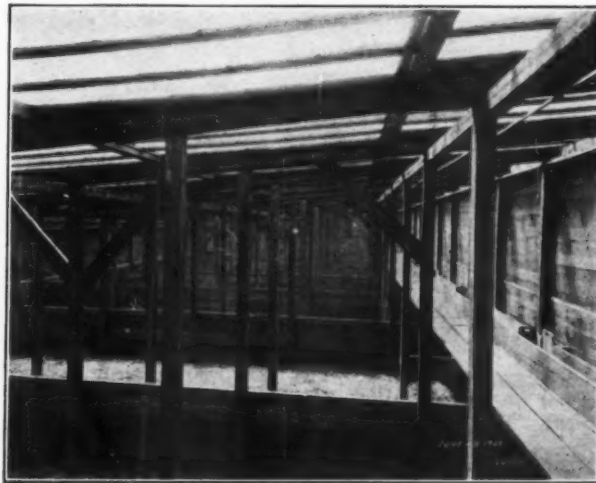
accurately recording the weight of the material discharged. The branch line discharges immediately into top-vented, cylindrical, cone-bottom steel plate target boxes, 4 ft. diameter and 6 ft. 3-in. high, one of which is suspended immediately above each of the charging ejectors, the function of which is to take the impact which occurs when the screenings shots are received from the screen house ejectors, this impact being due to the 80 pounds air pressure being used by the ejectors. The discharge into the target boxes is in a slightly downward direction and tangential to the cylinder periphery, the charge descending through the cone bottom and a flexible telescope canvas hose connection to the ejector.

When the screenings in the ejector have reached a certain predetermined height, this is automatically indicated to the operator in charge by the flashing of an electric light and he, when the time arrives for charging one of the compartments, throws a hand switch which closes the upper flap gate and immediately thereafter admits the compressed air very slowly to the ejector on top of the screenings, which gradually presses them out into, and through, any one of the four 6-inch pipes leading to the four digestion compartments. These pipes enter the compartments through the tank top and terminate about one foot below the liquor level therein. It is of the utmost importance that none of the air used in discharging the screenings be permitted to find its way into the digestion compartments where gasification is in progress, and therefore, by means of automatic electric facilities, the compressed air is shut off after the screenings level has been lowered a predetermined distance, and an effective screenings seal remains in the ejector cone bottom as well as in the vertical and horizontal pipe leading to the tank compartments. The automatic mechanism which shuts off the compressed air also exhausts the air contained in the ejector and immediately thereafter opens the upper flap gate and the ejector is again ready to receive screenings.

There is an opening in the roof immediately over each target box through which coarse screenings may be deposited by a locomotive crane if this should be desired. The ejectors also may be used for applying lime if it is thought necessary in maintaining optimum pH control.



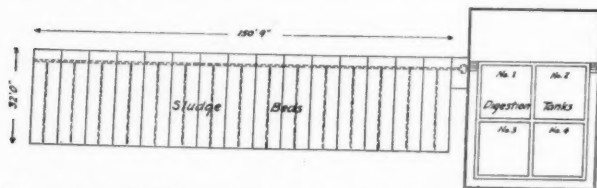
CHARGING EJECTOR AND TARGET BOX,
PARTLY ERECTED



INTERIOR VIEW OF SLUDGE BEDS

SLUDGE BEDS

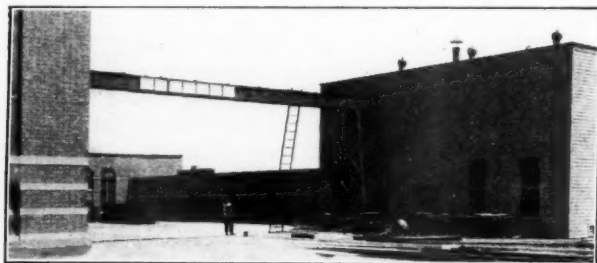
Each of the fifteen sludge beds is 10 feet by 32 feet, the filtering material being a 3-inch top layer of coarse graded sand on a layer of graded stone. The open trough bringing the screenings sludge passes across the wooden partition walls between the beds and stop plank control gates are provided in the trough opposite the center of each bed. Both beds



PLAN OF SLUDGE BEDS AND DIGESTION TANKS.

and enclosing structure are of temporary frame construction, the structure being 152 feet by 32 feet by 7 ft. 8-in. high on the low side and 10 ft. 8-in. high on the high side; the roof consisting of overlapping and sliding window sashes 5 feet wide, which can be slid away at any point to permit the use of a locomotive crane and clam shell for removing the dry screenings.

The entire plant is housed in a temporary frame structure. The room containing the four digestion compartments is completely lined with celotex, as is also the underside of the roof, to conserve heat and facilitate heat transfer determinations. The steam,



CONTROL HOUSE AT RIGHT, SCREEN HOUSE AT LEFT, AND PIPE BRIDGE CONNECTING THEM.

water, commercial gas and screenings pipes and the electric wires enter this building near the roof, being extended to this point from convenient cut-in points in the screen house through an overhead enclosed structural steel bridge.

Dr. Rudolf's description of the experiments, the results of which were used as a basis for designing this plant, will be given in the January issue.

Sewage Pollution of Stream Unlawful in Indiana

The Appellate Court of Indiana rendered an opinion on June 19 in the case of City of Frankfort vs. Jay D. Slipper, affirming the judgment of the Circuit Court holding the City of Frankfort liable for damages growing out of the pollution of Prairie creek by alleged unlawful deposit of sewage therein.

The court reviewed the facts and law governing stream pollution, considering the appellant's contentions: (1) that a city may pollute a stream so long as such discharge is without negligence; (2) neither evidence nor facts were sufficient to estab-

lish public nuisance; (3) certain statutes provided a method by which riparian owner might obtain relief, and having failed to avail himself of such statutory remedy, plaintiff cannot maintain this action.

The court held that the statutes simply give the State Board authority to enforce provisions of the act for public health and are not available to individual owners, who must seek relief through the courts as did the appellee in the instant case. Concerning contentions (1) and (2) the court said: "The rule of necessity thus declared must in and of itself inevitably force just the opposite doctrine, in the interest of the public health, the very thing supposed to be subverted by the rule, when it is daily becoming more and more apparent that the sewage in the streams is a real menace to the public health; and it is not a necessity, because it can be otherwise provided for, with practicability and assured safety to the public health."

"Far preferable and more consistent, both with private rights and the public interest, that the streams shall be preserved without contamination, and as arteries adequate to carrying the floods of water, continually increasing in quantity and velocity by reason of the agricultural drainage, precipitating them quickly into streams; and that no supposed rule of necessity in order to the carrying on of a business, on account of its usefulness or necessity, or that it cannot be carried on without producing these results, nor the fact of skill and care to prevent it, or on account of the amount involved, can be allowed as an exception; nor can the riparian owner below be required to protect himself; the right is an incident of the title, and such is the law of this state."

Salt Water Injures Roads

The Pennsylvania Highway Department has decided that ice cream trucks and similar vehicles which drip salt water upon pavements of Pennsylvania's highways will not be permitted to use them. Laboratory tests of the department have conclusively demonstrated that sodium chloride or common salt has a deleterious effect upon concrete and the highway officials have taken this action to prevent deterioration through the dripping of salt water. The law provides a penalty of \$10 fine or not more than 5 days imprisonment for a vehicle which is so constructed or loaded as to permit the contents dropping, leaking or otherwise escaping therefrom.

Housing Snow Fighting Equipment

The large amount of equipment for road construction and maintenance and snow removal which is owned by the Department of Highways of Pennsylvania has required more storage room than the state owns and in some districts it has been necessary to rent space, while all of the storage space is crowded. During the past fall the department has been erecting on state-owned ground 23 storage sheds of approved fire-proof design. The buildings are standardized, all-metal, with fire-proof ceilings designed to cut down air space and economize heating. The buildings will be for year-round use and equipped with offices for the maintenance superintendents.

Last year the department kept 7,110 miles of highways open for traffic during heavy snow storms, and more than 800 miles have been added this year so that the force will have about 8,000 miles of roadway to patrol during the coming winter. An important feature of the new storage provision will be a wider distribution of the equipment, having it within easy reach of the work, whether it be snow removal or construction. In case of a heavy local snow fall the forces will start from several directions at once before the snow reaches great depth and take up patrols to prevent serious drifting. Each locality will have added assurance that roads will be kept open constantly and none of the equipment will spend long periods travelling to and from the work.

City Paving on the Pay-as-you-go Principle

The financing of capital outlays from current revenues is now the practice of some communities for at least a part of their capital financing, or for all outlays made for specific purposes, according to the Chamber of Commerce of the United States. A bulletin issued by the Chamber states that roughly \$500,000,000 of the \$973,000,000 paid by cities of more than 30,000 population for capital outlays in 1925 came from current revenues, which indicates that the pay-as-you-go system, or some modification of it, already is an established fact.

Oil Treatment for Gravel Surfaced Roads in New Mexico

By R. W. Bennett*

New Mexico has some 1800 miles of gravel-surfaced highways, built largely with Federal Aid. Very little hard-surface construction, such as cement concrete or asphaltic concrete, has been possible because of the state's immense road mileage and limited financial resources. An abundance of native rock and gravel, however, has permitted the surfacing of this considerable mileage with crushed material.

This type of surfacing was fairly satisfactory and economical to maintain up to about three years ago. Since that time motor vehicle travel has increased so greatly that it is grinding up the gravel surface, the dust from which is blown from the road by the high winds which prevail over a great portion of the state. The resulting loss in gravel surfacing is from one-half to three-quarters of an inch annually, depending on the volume of traffic and prevalence of winds. In money this represents an annual loss of \$400 to \$600; or, in the event of replacement, the expenditure of this amount to keep these roads up to standard thickness. Add to this figure the cost of other necessary upkeep and replacement, and maintenance costs assume proportions prohibitive to New Mexico.

Nor is this the only problem which heavy traffic has occasioned. Corrugations develop, which during the protracted drouths experienced in the Southwest, cannot be completely eliminated by ordinary dragging and blading. And the dust nuisance is not the least of the inconveniences encountered.

INVESTIGATIONS MADE OF OIL PROCESSING

Seeking a remedy for these ills, New Mexico highway engineers made a study of conditions in other states and the methods used there for combating them.

Operating under similar topographic and climatic conditions, California engineers seemed to have found the most practical and economical solution as the result of experience and experiments there and

elsewhere with asphaltic road oil. The method selected as being the most adaptable to New Mexico is known as the "turn over" process.*

DESCRIPTION OF METHOD

Essentially this method of treatment consists in the application of approximately 1½ gallons to each square yard of crushed rock or gravel surface, thoroughly mixing the oil and surfacing material to form a mat or cake about three inches thick.

The work schedule for the oiling process is as follows:

- (1) Scarifying surface ahead of oil application.
- (2) Disc-harrowing ahead of oil application to take out traffic ruts and to present a fairly uniform surface to oil.
- (3) First application of oil.
- (4) Disc-harrow first application.
- (5) Second application of oil.
- (6) Disc-harrow second application.
- (7) Third application of oil.
- (8) Disc-harrow third application.
- (9) Mix with blades.
- (10) Lay-down for traffic.
- (11) Maintain with light blade under traffic blade will no longer move the mix.

DETAILS OF WORK

Where the existing gravel surface has been maintained to standard thickness, the first necessary operation is to scarify the surface to a uniform depth of three or four inches.

However, on the projects already treated in New Mexico, it was necessary, with one exception, to add about that thickness of crushed gravel, because of the worn condition in which these stretches were found.

This replacement represented an additional but necessary expense. The work of crushing and placing the material was done by the state by force account.

*Office engineer, New Mexico State Highway Department.

*This method as employed in California was described very fully in PUBLIC WORKS for October, 1927.

The oiling operations proper were also performed by a state crew under the direction of a superintendent thoroughly conversant with the "turn over" processing. The oil used is known as "medium road oil" or as "65% oil," which refers to its content of penetration asphalt.

After harrowing to loosen up the surface, the oil is spread on the road in three applications by a pressure distributor. Each application is approximately one-half gallon per square yard, the total theoretical application being one and one-half gallons per square yard. The oil distributor is handled by only a skilled operator, as it is very essential that an even flow be maintained.

The old surface is harrowed thoroughly after each application of oil, the tractor and harrow following the distributor to the end of a newly treated section and going back and forth over the section until the oiler returns.

After the third and final application of oil has been harrowed in, the actual mixing operations begin. A one-man motor grader is used for "turning over" the mix. The oiled material is thrown toward the center from each side, forming a windrow. It is then worked gradually to one side, making another windrow. This shifting process and rolling from one side to the other is kept up until the mixed material is of the proper uniform dark chestnut color and springy consistency.

The oiled surfacing is then "laid down" or spread expertly and uniformly across the entire road by skilled blade operators, when it is ready to receive traffic. The mixture compacts rapidly under traffic, offering practically no inconvenience. A blade is kept in operation continuously during the compacting period for the purpose of securing a smooth surface.

THE OILING PROGRAM IN NEW MEXICO

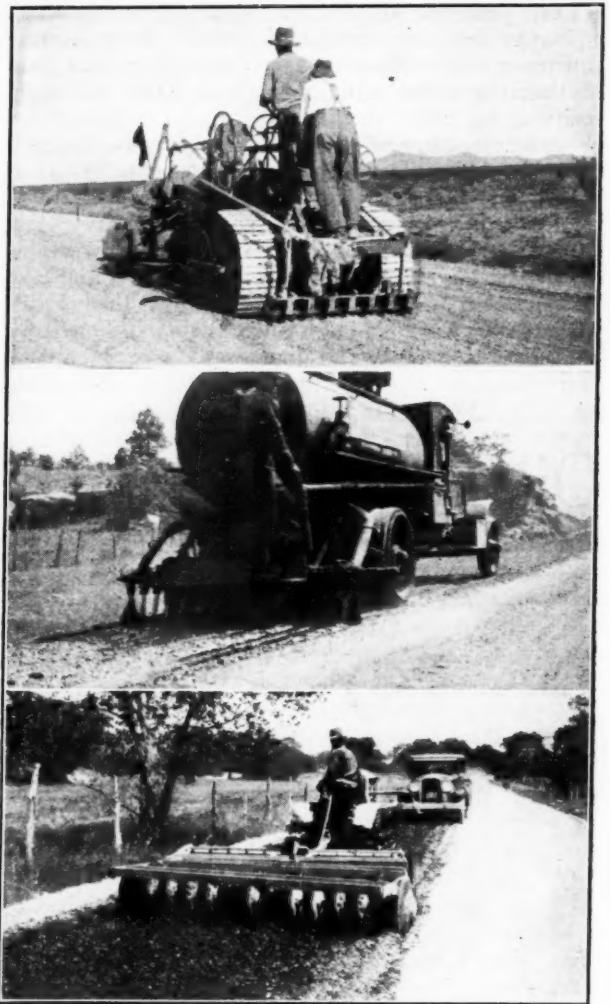
Eight sections of gravel-surfaced road located in different parts of the state were selected for the first oiling operations. Five of these projects have been completed; three are under way. They vary in length from eleven to seventeen miles, with one exception, which is two miles long.

The "turn over" process above described has been used on five of these trial sections. Cost figures are available on two jobs. Exclusive of the cost of placing additional gravel, the total cost for labor, supplies, oil and equipment on one of these projects was \$1,428 per mile. On the other the figure was \$1,388—both figures very close to the preliminary estimate.

"PRE-MIX" METHOD TRIED

On two of the projects now under way, a modification of the oil processing has been made. Instead of placing the new layer of gravel on the road and then distributing and mixing the oil with the new material, a mixing plant is erected at the crusher, the oil is applied there, and the material reaches the road completely mixed ready for spreading. It may readily be understood that this eliminates several operations and may result in considerable economy. Just what the saving may be it is impossible to say at this writing, as cost figures are not yet available. After being spread, the "pre-mixed" material is compacted under traffic with attendant blading exactly as is the case with the "turn over" process.

Approximately 100 miles of gravel-surfaced high-



TOP—SCARIFYING GRAVEL SURFACING PREPARATORY TO APPLYING THE OIL

MIDDLE—APPLYING THE HEATED OIL HALF THE ROAD IS WORKED AT A TIME TO NOT INTERFERE WITH TRAFFIC

BOTTOM—AFTER THE OIL HAS BEEN APPLIED IT IS HARROWED IN WITH A DISK HARROW

way will have been oil treated, either by the "turn over" or the "pre-mix" process, before winter sets in. An additional 50 or 60 miles are scheduled for oiling on new Federal Aid projects which are now under construction. This work will take place next year.

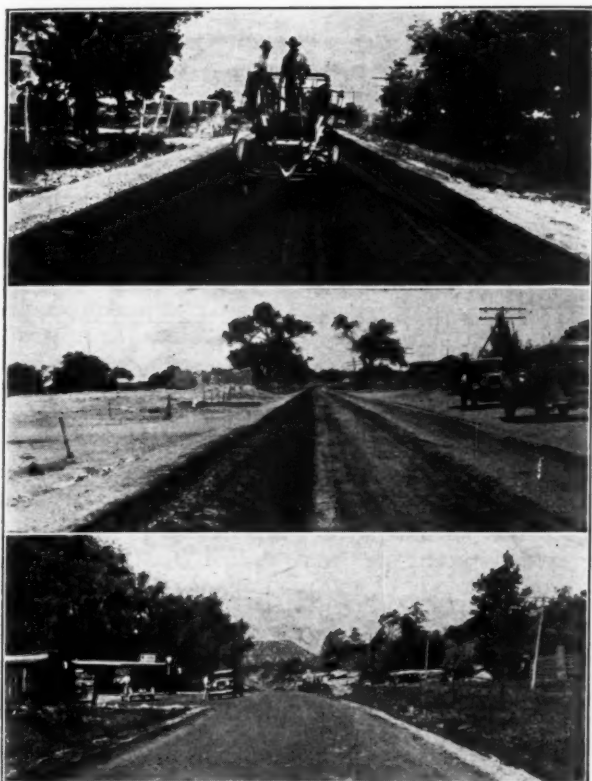
CONCLUSIONS

While "oil processing" is probably inferior to or less permanent than paving, it seems to offer an economical solution to many problems which gravel surfaced roads have presented. The riding qualities of the finished road are excellent, being superior in this regard to concrete, asphaltic concrete or bituminous macadam.

Probably the maximum traffic which these roads will sustain economically is about 200 vehicles per day.

Since traffic on New Mexico highways does not exceed 1,000 vehicles per day, except for short stretches near thickly settled communities, it is believed that oil treatment on most of the gravel-surfaced mileage will prove a great boon.

The annual loss of surfacing material will be neg-



TOP—THE MIXING PROPER IS DONE WITH A ONE-MAN GRADER

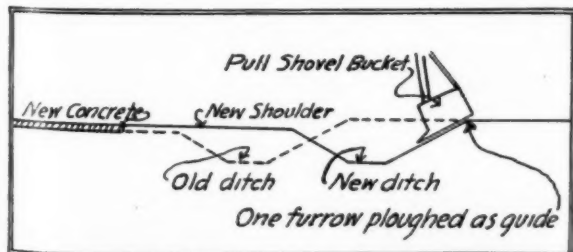
MIDDLE—THE MIXTURE IS WORKED FROM ONE SIDE OF THE ROAD TO THE OTHER UNTIL UNIFORM COLOR AND TEXTURE ARE OBTAINED

BOTTOM—COMPLETED OILED ROAD, GLORIETA, N. M.

ligible, maintenance will be easier during dry periods and corrugations more readily overcome. The dust nuisance will be eliminated as far as the road itself is concerned. Also it is hoped that maintenance costs, which have threatened to become so large as to seriously curtail needed new construction, may be reduced to a figure less menacing in aspect.

Reditching Road With Pullshovel

In widening a six-mile stretch of highway between Saginaw and Flint, Michigan, which involved filling in the old ditch and digging a new ditch outside of it, using the material from the new ditch for filling the old and for widening the shoulder up to the level of the surface of a new concrete pavement, Alex Jeffrey of Saginaw handled the 20,000 cubic yards involved with practically no labor except the operator of a pullshovel, and the driver and team employed for running a furrow by plow along the



PROCEDURE OF REDITCHING ROAD

outer line of the new ditch to serve as a guide to the pullshovel operator.

He used a Northwest pullshovel, bolting to the bottom of the bucket of this shovel a sheet of one-inch steel six feet long and four feet wide with the edges of the sheet sharpened. The shovel, which was on crawler tractors, ran on the concrete pavement and with one operation excavated the new ditch and pulled the material so excavated from the new ditch into the old ditch and onto the shoulder. At times as much as three yards of dirt was carried with a single movement of the bucket. The entire six miles of widening was completed in three weeks. Mr. Jeffrey says that undoubtedly a pullshovel bucket five feet wide and fairly shallow would be ideal for this kind of work, but his arrangement gave good results.

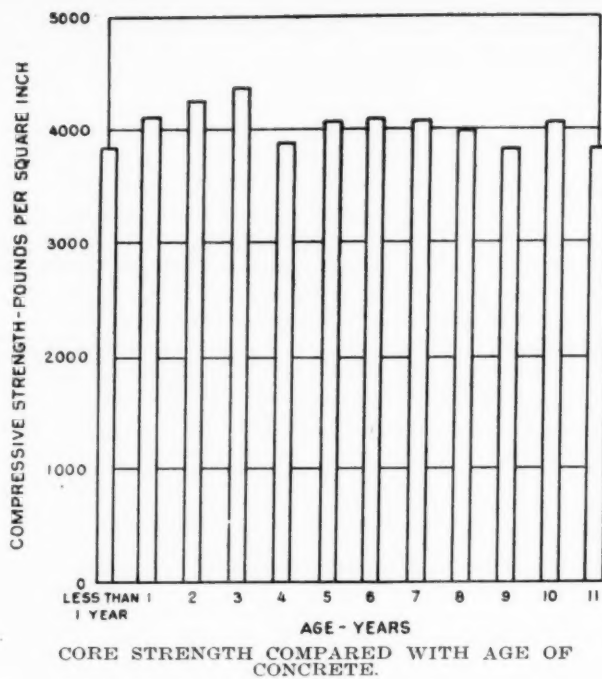
Core Tests of Concrete Pavements

Analysis of data obtained by testing more than two thousand cores from Maryland highways. Crushing strength. Effect of hauling mixed concrete.

A number of investigations dealing with the general subject of strength characteristics of concrete have been carried on during the past six or seven years cooperatively by the Engineering Experiment Station of the University of Maryland, the United States Bureau of Public Roads, and the Maryland State Roads Commission. This investigation included analyzing data obtained by testing some 2,200 cores drilled from concrete pavements of the state highway system of Maryland during the summers of 1921 to 1926. The report on this phase of the investigation has recently been prepared by A. N. Johnson, Dean of the Engineering College of the University of Maryland, and published by the Bureau of Public Roads.

For various reasons, a small percentage of the test results were discarded in making the analysis, but the results are based upon more than 2,000 cores tested. The average crushing strength was found to be 4,079 pounds per square inch. The individual specimens varied in strength from 1,800 pounds to 7,800 pounds. However, only 12% of the total cores tested less than 3,000 pounds per square inch, and only 15% showed a greater strength than 5,100 pounds, leaving 73% within a range between 3,000 pounds and 5,100 pounds. It was, therefore, concluded that "under the usual construction conditions that prevailed in Maryland, concrete that will test upward of 3,000 pounds per square inch may reasonably be expected, and that concrete road cores which test much below this value are exceptional."

Comparison was made as to the effect of age and character of aggregate on strength. It was found that the highest average was for cores three years old, the lowest for cores nine years old, but that there was a range of only 554 pounds between these ages, which was about equally divided above and below the average value for all cores for all ages, this average being 4,079 pounds. "The obvious conclusion drawn from these data is that they indicate



CORE STRENGTH COMPARED WITH AGE OF CONCRETE.

that no definite influence on the strength of the concrete is to be attributed to the age of the pavement within the age limits of the specimens tested."

Comparing the crushing strength of the cores on the basis of the nature of aggregates, the highest value is for what appeared to be mixed rock (possibly crushed gravel), 4,278 pounds per square inch. Limestone aggregate averaged 4,241 pounds, and the lowest was for slag aggregate 3,492 pounds. Here also the range was small—only 786 pounds, which was nearly equally divided below and above the average strength of 4,079 pounds.

Study was also made of the effect on the strength of concrete of hauling after mixing. It is often convenient to plan concrete road work so that the mixed concrete is hauled to the road from a central mixing plant. This was the method used for placing the concrete shoulders on the Baltimore-Washington road near Muirkirk. The central plant was

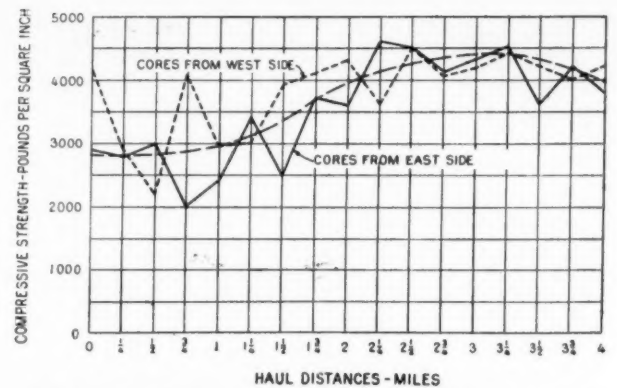


DIAGRAM SHOWING RELATION BETWEEN COM-
PRESSIVE STRENGTH AND LENGTH OF HAUL OF
CONCRETE MIXED AT A CENTRAL PLANT.

located near Muirkirk station and the concrete was hauled various distances up to four miles to construct the shoulders on each side of the road. Groups of three cores were drilled from the shoulders on each side of the road at quarter-mile intervals. Thus there were six cores drilled one-quarter mile from the mixing plant, six at one-half mile and so on up to a total distance of four miles. Comparing the average compressive strength for each group of three cores, the results indicate that there is a gain in strength with increasing length of hauling for the first two or three miles and a slight falling off in strength for a haul of four miles. In general, the concrete that had been hauled four miles was somewhat stronger than that hauled for a short distance only. While the results may not warrant precise conclusions, certainly it may be concluded that hauling the concrete three or four miles after it had been mixed in no way injured it and probably actually increased its strength.

Hope For Uniform Traffic Regulation

In a paper before the American Society for Municipal Improvements entitled "Are Essentially Uniform Municipal Traffic Regulations Utopian?" Arthur H. Blanchard stated that "an essentially uniform traffic ordinance should defin-

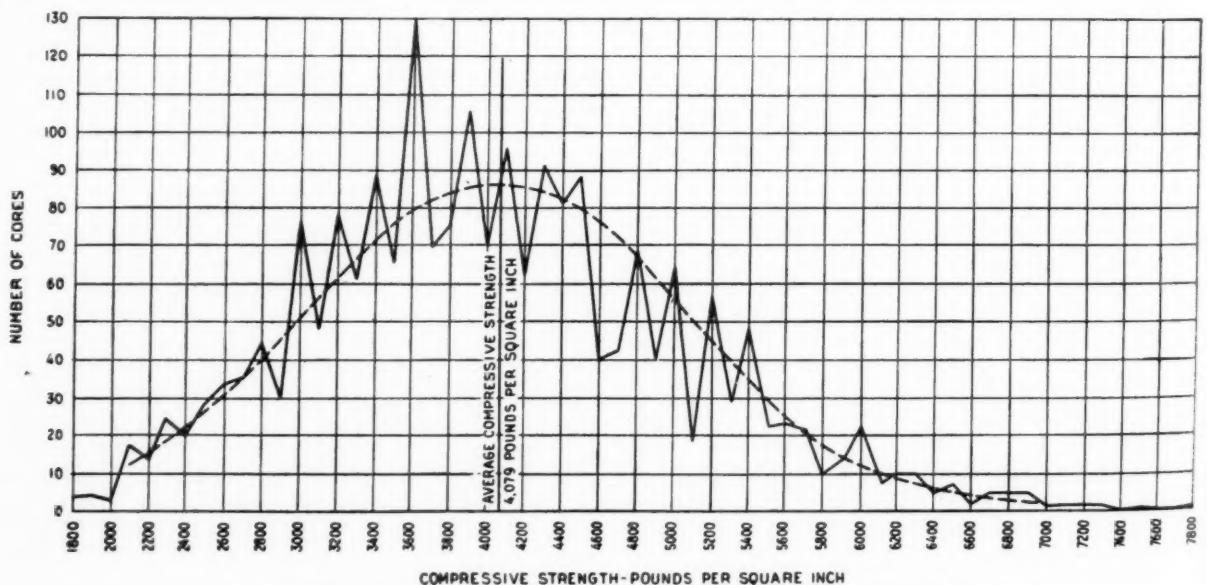


DIAGRAM SHOWING DISTRIBUTION OF CORES ACCORDING TO CORE STRENGTH.

itely cover every traffic regulation which cannot be readily and practically indicated by signs and signals." Also that "safety of pedestrians and vehicular operators positively required that signs at street intersections should be of a number approaching the irreducible minimum as the desired limit."

At the instance of Secretary Herbert Hoover, a committee of 100 men endeavored to prepare a model municipal ordinance, but the ordinance adopted is by no means entirely satisfactory "because it contains, relative to several important sections, the dictum: If you don't like this traffic control recommendation, please adopt the following alternate regulation." One example of this is that of traffic control signals, for which the primary recommendation is the three-color system, but with the alternate recommendation of the two-color system with a different meaning for the red signal than in the case of the three-color system.

There is such a diversity of opinion on this matter of traffic regulations, that Mr. Blanchard finds only one hope for a nationally universal set of regulations. "When Congress shall have passed a bill providing for the establishment of a system of national highways, as advocated by the National Highways Ass'n. and comparable to that under the jurisdiction of the National Department of Roads and Bridges of France, then we may hope for the adoption of an essentially uniform municipal traffic ordinance." Should this be done, Congress will probably empower the U. S. Bureau of Public Roads, a national highway commission, or the Interstate Commerce Commission, to regulate and enforce regulations applicable to traffic on all highways comprising the national system. Since these highways will traverse every state, the motoring public will soon compel the several states to make their regulations conform to those in force on the national system, and this will naturally be followed by an adjusting of municipal regulations also to conform to them.

Abrasion Tests for Stone and Gravel

In our November issue we published an article with the above title. It should have been accompanied with the illustration shown herewith, but the photograph was not received in time. It shows so clearly the nature of the synthetic gravel that we present it this month.



CRUSHED STONE, AND SIMILAR STONE CONVERTED INTO SYNTHETIC GRAVEL.

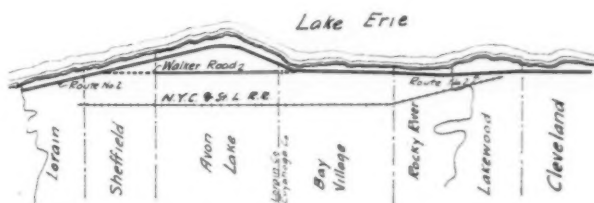
Record Paving Job by Avon Lake Village

An average of two hundred and fifty-six cubic yards a day for twenty-seven days. Construction methods.

By Henry F. Alexander*

Greater Cleveland includes practically all that territory between Lorain, Ohio, on the west and Painesville, Ohio, on the east, a distance of about 54 miles. Lake Erie forms the northern boundary for the entire distance. The highway paralleling the lake forms a very attractive route for motoring, especially so for tourists. Travel on this route (State Route No. 2) is very heavy, especially during the summer season. To divert a portion of this traffic from Route 2 and at the same time give the farmers in the vicinity better facilities for reaching the market at Cleveland and Lorain, it was decided to improve a road locally known as Walker road by concreting the existing road and extending it both east and west to connect at both ends with Route 2. It thus forms the string of the bow formed by Route 2.

Lakewood, Ohio, is the main entrance to Cleveland from the west. Between Lakewood and Lorain are the villages of Rocky River, Bay Village, Avon Lake, and Sheffield, each of which is a live, energetic embryo city, having Lake Erie as its northern boundary. All these villages will experience a great development in the near future and are preparing for it. Walker road will cross Avon Lake and part of Sheffield Village and of Bay Village. Avon Lake took the lead in the improvement of this road and late in the summer of 1928 awarded the con-



SKETCH SHOWING LOCATION OF WALKER ROAD. DOTTED LINES SHOW PROPOSED EXTENSIONS.

tract for paving the road across the entire width of the village, a distance of 26,802 feet. Deductions for cross roads already paved and additions for intersections to be built give an equivalent of 26,864 feet.

The contract was awarded to the Ohio Engineering Company, of Lorain, Ohio, and it in turn sublet the western 5,422 feet to the Glover Contracting Co. of Lorain, leaving 21,442 feet to be built by the Ohio Engineering Company. The contract calls for the completion of the job in 60 working days favorable for paving construction.

The first concrete on this job was poured on September 10, 1928. Several weeks of good weather followed, enabling the paving to proceed with only a few unfavorable days until October 15, when there

*Member of Ohio Engineering Society, American Association of Engineers, and American Road Builders' Association

Warden & Laundon, civil engineers, of Elyria, are the village engineers. The Ohio Engineering Company's representatives on the work are: James Van Wagnen, foreman of concreting operations; Walter Read, in charge of grading, and Dwight Jones, mixer operator.

After October 15th the weather was very unsettled, much time was lost owing to the wet condition of the ground and no further records were made.

As far as can be ascertained, the record for paving made on this job between September 10th and October 15th is the highest ever made in this district. In making this record there was no sacrifice of quality for quantity. Every effort was made to produce an A1 road and the village got that. Any future failure of this road will not be on account of insufficient cement, careless mixing or inattention to details.

Pipe Laying and Testing at Greenwich

Five miles of twenty-four-inch cement-lined cast-iron pipe tested with compressed air instead of water. Air pressure fifty to seventy per cent of water pressure

In connection with the extensive improvement and enlargement of the water plant at Greenwich, Connecticut, as already described in PUBLIC WORKS, considerable interesting work was done in connection with laying the pipe lines and testing same. This was described by Dana M. Wood, of Stone & Webster, Inc., in his paper before the New England Water Works Association's convention, and this part of his paper is given in full below.

A 24-inch diameter cement-lined cast-iron pipe line of Classes A, B and C was laid from the Putnam Lake purification plant to Port Chester, the lower end changing to a similar 20-inch Class C line. A 12-inch diameter cement-lined de-Lavaud centrifugally cast branch line was laid to Glenville, in turn branching into 8-inch and 6-inch lines without cement lining. A minimum cover of three feet was adopted for the main line, which in part followed highways and in part traversed private rights of way across country. For the most part the line passed through territory heretofore unserved with a public water supply.

Including main lines, cross connections and spurs, there were laid 27,017 feet in Connecticut, 9,993 feet in New York State, and 6,530 feet in Glenville; a total of 43,540 feet. Included in the total length in Connecticut were two bridge crossings and a Venturi meter and by-pass installation at the Connecticut-New York line.

A total of 4,521 tons of cast-iron pipe and fittings, valves, etc., was installed in the pipe lines and 350 tons at the purification plant. This tonnage would require four freight trains of 50 cars each.

The estimated number of joints was as follows

Diameter Inches	Number of Joints
30	3
24	2,681
20	424
16	23
12	263
8	394
6	113
4	21

On the main line in Connecticut the equivalent of 19.5% of the length was solid rock, and in New York it was 8.5% of the length, while the Glenville branch ran 19.05%. Extra earth excavation (i. e. necessary departures from standard trench) ran 0.0251 cu. yds. per linear foot of trench in Connecticut, 0.077 cu. yds. in New York, and 0.002 cu. yds. on the Glenville branch.

All Class C pipe was laid with 2½" depth of lead in joints, and lighter pipe with 2" depth. A theoretical calculation of the lead required for a portion of the line gave 46,844 lbs., whereas records of actual lead used gave 49,190 lbs., or about a 5% excess. Untarred hemp was used for packing for lead joints and braided hemp for lead Hydro-tite joints.

Lead joints were adopted for the main line because there was no satisfactory water supply available for healing substitute joints. On the Glenville branch, however, which was laid subsequent to and working out from the main line, lead Hydro-tite joints were successfully used, joints being 2½" deep.

All 24" and 20" pipe was laid on wooden blocks 3" x 10" x 24". All 45° bends and where deemed necessary other bends were anchored in concrete blocks.

On cement lined pipe the contractors were not allowed to use hammer and cold chisels in cutting, because of damage to the lining. A No. 3 French patent pipe cutting machine as made by A. P. Smith Company was used satisfactorily. After removal of any loosened cement, the exposed metal was coated with Barrett's "Ever-jet" black asphaltum. Ingersoll-Rand 2-R air hammers were used in caulking lead joints.

TESTING JOINTS WITH COMPRESSED AIR

Because of the lack of water even for testing most of the main line, the joints were generally tested with air only. In some sections where water was available, comparative water and air tests were made to determine proper specifications for future use in the air testing method. An interesting outcome of the use of the air for testing was the enthusiasm for it by the sub-contractors, who at the start were prone to con-

demn it, and also the fact that better joints were obtained than by the customary water tests.

A water test of 150% of the static was first specified, and in the event that it was necessary to use the air testing method, it was specified that from 60 to 70% of the water test pressures should be used. Under the air test the joint was painted with soap suds made from Lux soap. At any point where bubbles occurred the joint was recaulked until tight.

Where there was water in the trench, a leak under water was easily found, whereas with the water test it would have been necessary to pump out the trench before testing. Furthermore, the contractor had a dry trench in the usual case after testing with air, whereas with the water test, the water had to be disposed of before proceeding with work on the next section. With an air compressor in use for caulking, it was a simple matter to pump air through the test plug.

One difficulty at first encountered was in making the test plug tight against air leakage. This was overcome by leading in the plug and later cutting it out. No gaskets experimented with were found satisfactory with the standard plug, which has a tendency to spring under pressure at the contact edges.

The general conclusions reached from the air tests were that a pressure of not less than 30 lbs. per square inch minimum should be used in all cases; that, generally speaking, from 50 to 70% of the static pressure was satisfactory; and that the maximum pressure used should not exceed about 110 lbs. per square inch, as being the highest obtainable pressure from the usual air compressor available for pipe line work, the joints passing the test of the latter pressure being satisfactory at least up to the static head of about 300 ft. encountered on this job. Difficulties increased in obtaining higher air pressures. Air will show through a joint where water will not, and an air test is therefore much more severe than a water test.

It is to be admitted that the one objection to the air test is that the pipe itself may in some instances not be subjected to a high field pressure test after laying. To obviate this, the inspection of the pipe in the foundry and after delivery should be unusually rigid, and where possible the completed pipe line should be subjected to the customary water tests.

A summary of the results obtainable by air testing is given on the accompanying plate, which shows the data obtained from a very severe water test made on a section of the main line

5.17 miles long, up and down hill. Some sections received a pressure test of between 400 and 500% under this test, instead of the usual 150%. It should be noted that the leakage was only a small amount of that usually specified as a limit.

Notes on Tests: One-inch meter when standardized proved to be 25% to 30% slow for rates of flow from 1 to 3 cubic feet per hour. Uncorrected meter readings are plotted.

In test No. 3, pressure at upper end of line where water was introduced was from 11½ to 12 lbs. per square inch, mostly the latter.

Length of line tested, 27,242 linear feet = 5.17 miles of 24" pipe.

Estimated Number of Joints Under Test

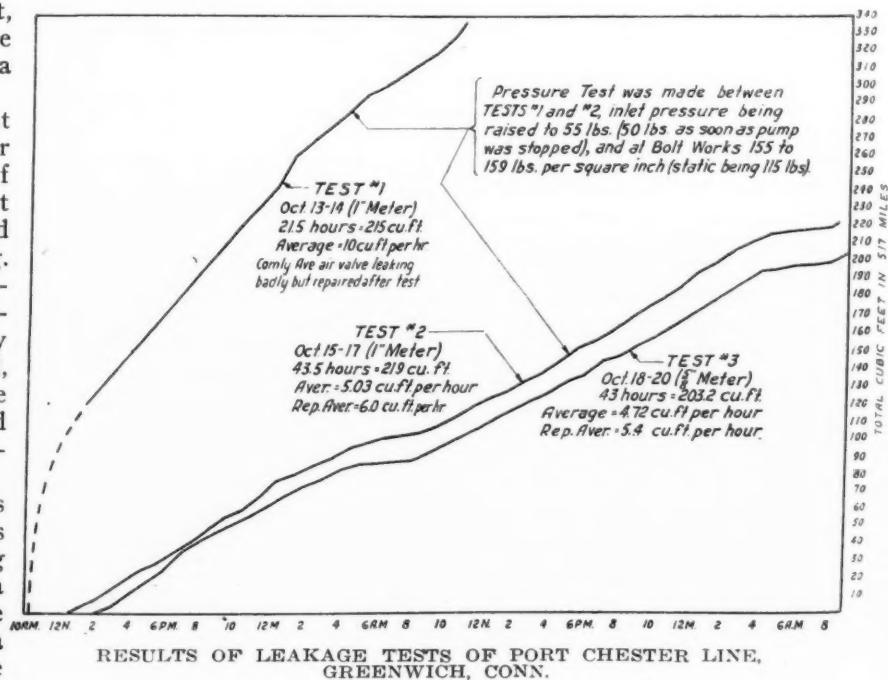
Size of Pipe	Number of Joints	Linear Feet Per Joint	Total *
4"	12	1.047	12.6
6"	37	1.571	58.1
8"	19	2.094	39.8
12"	6	3.142	18.9
16"	2	4.189	8.4
24"	2329	6.283	14633.1
24" flgd.	9	6.283	56.5
Total	2414		14827.4
Aver. per Mile	467		2870
Aver. per Joint		6.14	

*Based on "Nominal Diameter" of Pipe.

Summary of Tests

	No. 1	No. 2	No. 4
Average leakage, cubic feet per hour.....	10	5.03	4.72
Representative leakage, cu. ft. per hour.....	10	6.0	5.4
Leakage, gallons per day	1800	905 to 1080	850 to 972
Per mile of pipe....	348	175 to 209	164 to 188
Per inch diameter per mile.....	14.8	7.4 to 8.9	7.0 to 8.0
Per linear foot of joint	0.121	0.061 to 0.073	0.073 to 0.066

Aver. length of joint $\times 12$
 †Average diameter = 3.1416



Water tests of the Glenville branch lines laid with lead Hydro-tite joints also showed the following satisfactory results:

Test	Linear Feet	G.P.D. per Linear Foot of Joint	Days Healing
1	1195	1.21	6 to 34
2	679	0.15	
3	189	0.53	14 to 18

Since placing in operation, two failures of de-Lavaud pipe have occurred.

CEMENT LINING

Another interesting feature of the work was the cement lining of the pipe. A considerable quantity of the earlier shipments from the Bessemer plant was rejected because of loose spots, thin lining and shrinkage cracks. No pipe was accepted having a loose spot larger than 12 inches in diameter. Experimental treatment of shrinkage cracks did not prove satisfactory, the best treatment apparently being grout and water glass. Burning out joints will destroy the cement lining over adjacent areas, so that it is preferable to remove defective joints with a cold chisel.

The ordinary standard specifications for cement lining were followed. These have been presented by Charles W. Sherman in the Journal New England Water Works Association, Vol. 40, page 104. Subsequently, after encountering the above mentioned difficulties, the required thickness was decreased to that sufficient to cover well all rough spots in the iron itself. This resulted in much improvement in the character of the lining. Our modified specifications put the responsibility squarely up to the manufacturer to produce a lining free from objectionable loose spots and shrinkage cracks, and adhering tenaciously.

The only variation from the usual specification for the pipe itself was in respect to the chemical composition, as follows:

	Content	
	Maximum	Minimum
Sulphur .....	.10%	.....
Phosphorus ....	.90%	.....
Manganese ....	.55%	.35%
Silicon	2.00%	1.60%

The pipe was furnished by the U. S. Cast Iron Pipe and Foundry Company, which cooperated in excellent fashion throughout the job.

Upper San Leandro Water Project

Part of property recently acquired by
East Bay Municipal Utilities District,
California.

By Charles W. Geiger

The East Bay Municipal Utilities District has acquired the property of the East Bay Water Company, of Oakland, California, paying \$35,000,000 for the same. The East Bay Water Company had recently completed, as a part of the property purchased, the upper San Leandro water project, at a cost of about \$3,000,000.

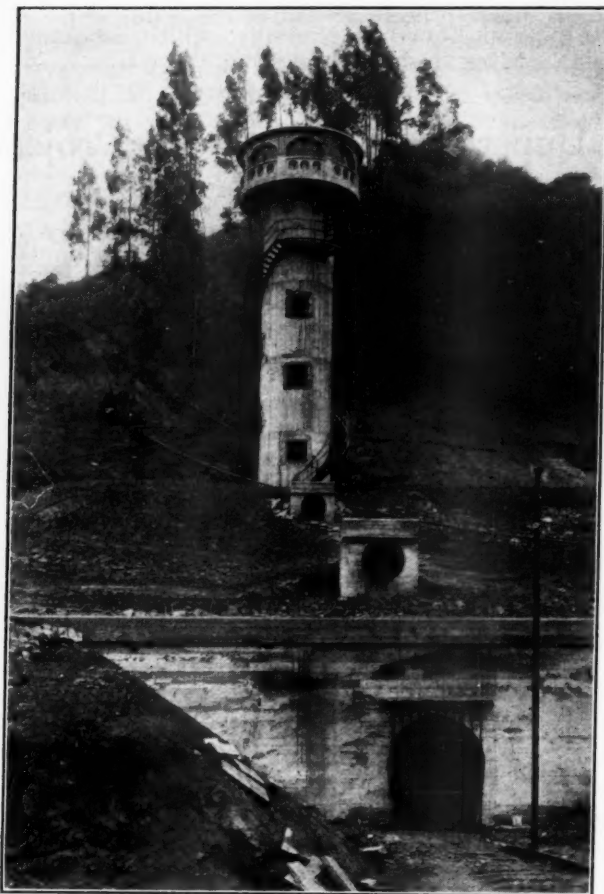
This project consists of a dam creating a reservoir six miles long, a supply tunnel running beneath the hills to Oakland, a filtration plant, and the connecting pipe lines. The reservoir, which has a capacity of 16,000 million gallons, is located six miles up stream from the Chabot dam and impounds water from a water shed of more than thirty square miles, which is well wooded. The reservoir, when full, will cover about 770 acres, storing the water in relatively deep, narrow canyons, which tend to prevent organic growth and to maintain the water at a low temperature.

Upper San Leandro dam is an earthen structure built by the hydraulic process from materials sluiced from borrow pits adjacent to the site of the dam. This type of dam was selected as that best suited to the conditions, one reason being that it would not be seriously affected by earthquakes. The dam is 185 feet maximum height and 656 feet long at the crest, with a crest width of 75 feet and a maximum base width of 1150 feet. It contains about 1,260,000 cubic yards of material.

Two spillways are provided. An open spillway is located at the southern end of the dam, which is lined with concrete and is carried downstream for a considerable distance below the toe of the dam, which eliminates any possibility of undercutting the same.



DAM PRACTICALLY COMPLETED. SPILLWAY AT RIGHT.



CONTROL TOWER AT ENTRANCE TO SUPPLY TUNNEL

The second spillway is a concrete-lined diversion tunnel driven through bed rock around the south end of the dam. The primary purpose of this tunnel was to carry the flood flow of San Leandro creek around the location of the dam during the construction period; while in the operation of the project, it will be used to release water to Lake Chabot.

A supply tunnel was bored from the reservoir directly to the distribution system. The inlet of this is located in Redwood creek, above the dam. This tunnel is 7,155 feet long, has a cross sectional area of about 30 square feet, sufficient to permit a flow of about 100 million gallons of water daily.

Two regulating towers were erected, one at the

reservoir end of the supply tunnel and the other at the inlet end of the diversion tunnel. These towers have inlet openings located at various depths, to draw off water at any desired depth and to permit drawing it off at any desired rate.

From the outlet of the supply tunnel, a riveted steel pipe line was laid to the filtration plant, which is located at Mountain Boulevard, near the state rifle range. All of the reservoir water is filtered before being discharged into the distribution reservoirs of the company.

The company owns 45,100 acres of water-sheds for the protection of its supply and has four large storage reservoirs—San Pablo, Upper San Leandro, Chabot and Temescal.

The Upper San Leandro development increases the storage capacity from 19 billion gallons to about 35 billion gallons. The storage reservoirs supply a small portion of the low-lying section of the district by gravity; but, owing to the hilly character of the East Bay District, water service must be provided at various elevations from sea-level to that of about 1400 feet, necessitating a great amount of pumping to lift the water to the residences on the hills. Much of the water served to the consumers is pumped an average of two times before delivery and in some instances passes through seven sets of pumps. The company maintains thirty-five pumping plants and fifty-two distribution reservoirs and tanks as a part of its distribution system.

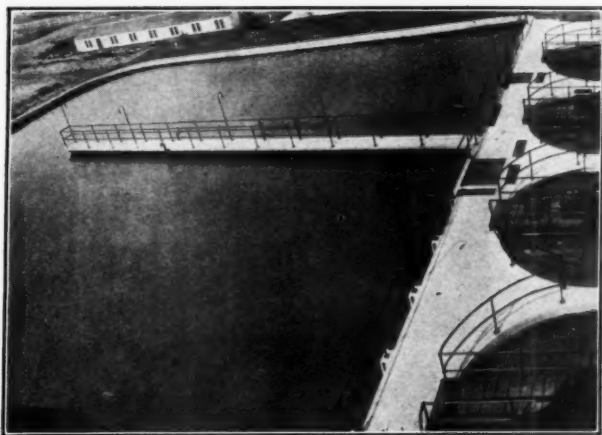
A completely equipped laboratory is maintained and bacteriological and chemical analyses of water are made. Samples are collected daily from many points in the system and each is tested at once to insure the continuous safety and purity of the supply.

On reaching the filter plant, the water first passes through aerators for removing any disagreeable taste and odor from the water. It then passes through a meter to mixing wells where the coagulating chemicals are applied, after which it passes to sedimentation basins, of which there are two, and from these to the filter beds. Each filter bed has a sand area of 540 square feet, there being 30 inches depth of sand on 18 inches of gravel graduated in size.

After filtration the water is treated with liquid chlorine and passes to the clear water reservoir. This plant has a rated capacity of 12 million gallons of water per day but is so constructed that capacity may be increased by the installation of additional filter units.



AT LEFT, DAM UNDER CONTRUCTION. AT CENTER AND RIGHT, TWO BORROW PITS FROM WHICH EMBANKMENT MATERIAL WAS SLUICED. AT LEFT CENTER, SLUICING FLUME ON TRESTLE.



AT RIGHT, FOUR MIXING WELLS. THERE IS A SETTLING BASIN ON EACH SIDE OF THESE.

The grounds around the filter plant are carefully landscaped to conform to the surrounding topography and planted with shrubs and flowers, creating an attractive park, the grounds being enclosed with an ornamental fence.

Some Water Works Data

According to reports by state sanitary engineers, there are approximately 9,800 water works systems in the United States; but these include all sizes, some very small, such as summer hotel and camp supplies, industrial systems and very small installations. The number of water works sufficiently large to be of commercial importance is estimated at about 3,000. There are 1,467 cities having a population of 5,000 or more each, all of which probably have water supplies. There are about 1,400 towns and villages of 2,000 to 5,000 population and a survey made by PUBLIC WORKS in 1927, covering 900 such places, showed that 87% of these had water systems. Under the 2,000 population mark, the percentage of places supplied with water decreases rapidly.

Of the 3,000 water supplies, about 70% are municipal and 30% private. Privately owned plants are most numerous in Pennsylvania, New York, New Jersey, Maine, Connecticut and Rhode Island.

The number of plants in individual states follows quite generally the population, New York, Pennsylvania, and New Jersey leading, followed by Illinois and Texas.

The above general statements are based on a survey made by PUBLIC WORKS in 1927 covering 900 places of 2,000 to 5,000 population and 728 cities of 5,000 population and over, which was supplemented in 1928 by surveys covering 491 cities of 5,000 or more population and 1,098 cities, towns and villages of between 1,500 and 5,000 population located in all the states.

Based on these surveys, after a very careful study of the returns as a whole and of individual replies, some general conclusions have been reached which are approximate but are believed to be conservative. The figures as reported have been checked by various methods and reviewed in the light of a wide practical experience in water works construction and administration.

Services: There are about 7,000,000 services in use and the annual increment of services amounts

to about 415,000, or 6%. By far the greater part of this increase occurs in cities of 5,000 and more population.

Meters: Cities of 5,000 and over have in use 4,775,000 meters. The total in all cities, towns and villages is in excess of 5,000,000. Cities of 5,000 population and over in 1927 placed 335,000 meters, and cities, towns and villages of smaller size placed 73,000. The total annual demand for meters is therefore in excess of 400,000.

Hydrants: There are in use in these 2,787 municipalities an aggregate of 650,000 hydrants. The number installed in 1927 totalled 50,500, made up of purchases of 38,500 by the larger cities, and 12,000 by the small places.

Gate Valves: The number of gate valves in use in the distribution systems of cities, towns, and villages, appears to be about 850,000. Records regarding gates, many of which have been in use for many years, are poor. The number installed in 1927 aggregated 67,000.

Wilkes-Barre Street Cleansing Records

The Wilkes-Barre, Pa., Street Cleansing Department lets the cleaning of its streets by contract but provides for keeping a close inspection of the work done, the inspector reporting twice a month on forms prepared for this purpose.

The streets are divided into six groups, each with a different cleaning schedule. Group 1 consists of those paved streets which are to be cleaned every day during both summer and winter by patrol hand cleaning, and every other day during the summer period by high pressure motor-driven flushing.

Group 1B consists of streets which are cleaned every Tuesday, Thursday and Saturday by patrol hand cleaning, and flushed every Friday during the summer period by machine flushing.

Group 2 includes streets cleaned every other day—Tuesday, Thursday and Saturday—during the summer period by machine brooms, and twice a week—Monday and Friday—by machine flushing in addition to the machine broom cleaning.

Group 3 includes streets to be cleaned during the summer period by machine broom cleaning every other day, namely Monday, Wednesday and Friday, and machine flushed on Thursday.

The streets included in Group 4 are cleaned twice a week during the summer period by a machine broom, and once by machine flushing; one sub-group being broomed on Tuesday and Thursday and flushed on Saturday, while the other sub-group is cleaned by machine broom on Monday and Friday and flushed on Wednesday.

The streets of group 5 are cleaned on Monday and Friday during the summer period by machine broom, and by machine flushing once every two weeks, this machine flushing taking the place of one broom cleaning.

In each of the above groups, the bids include also maintaining refuse cans.

The sixth group includes four streets and the public square, which are included in the first

group but which, in addition, are cleaned by machine brooms every Sunday and holiday morning during the year (except when snow lies on the pavement) before nine o'clock in the morning.

In the form provided for reporting twice a month on the work done, a page or more is devoted to each group and on this page are listed all the streets included in the group, together with the total number of square yards of cleaning included in each street or part of a street so listed; also columns for each week-day of three weeks (allowing for one full week and a fractional week at either end), with a final column for the total number of square yards of cleaning done on each street during that period. A check mark in each of these columns opposite each street name indicates the day on which that street was cleaned. At the foot of the page is entered the total number of square yards cleaned for that half month.

At the end of the report is to be entered the number of foremen, of men in the hand district, of men outside of the hand district, of hand carts, flushers, trucks, sweepers and sprinklers, two-horse wagons and refuse cans. Also the wages per day of each class of men so reported.

The total yardage of all of the streets listed in each of these groups is as follows: In group No. 1, 242,600 square yards; in group 1B, 66,900 square yards; in group 2, 144,200 square yards; in group 3, 143,900 square yards; in group 4, 412,500 square yards; in group 5, 84,600; and in group 6, 47,500 square yards. It is seen that much the largest area is included in group 4, cleaned every third day and flushed once a week; and the next largest area in group 1, with patrol hand cleaning every day and motor flushing every other day during the summer period.

Street Cleaning in Small Communities

Report of Committee on Street Maintenance, Street Cleaning and Snow Removal, of American Society for Municipal Improvements

A year ago this committee summarized some statistics concerning the use of street cleaning machinery in cities of more than 5,000 population, from which it appeared that there was a very general use of such machinery even in cities under 20,000. During the past two months the chairman, as editor of *PUBLIC WORKS*, has collected data from about 1,000 municipalities of less than 5,000 population, located in every state of the union, showing that a great percentage of even these smaller communities use more or less special equipment for the purpose.

For the purpose of presenting these data in brief form and at the same time indicating what, if any, relation there is between such use and the geographical location, the communities

have been grouped in accordance with the districting of the country as adopted by the Federal Government—New England States, Middle Atlantic, South Atlantic, East North Central, East South Central, West North Central, West South Central, Mountain and Pacific.

Sixty-one and one-half per cent of all these report the use of only hand brooms and other hand equipment, 90% of the New England municipalities so reporting, and, at the other extreme, only 28% of the Mountain district; the other districts ranging from 55% to 75%. In addition, about 7% report the use of hose for flushing, this practice being especially common in the Mountain district.

Of the machinery used, the horse-drawn rotary broom is most common, being reported by 20% of the South Atlantic, 19% of the East North Central, 18% of the Middle Atlantic, 17% of the Pacific, 16% of the West North Central, 12½% of the Mountain, 10% of the New England and East South Central, and 8½% of the West South Central.

Flushers are next in order, being reported by 28% of the Mountain municipalities, 13% of the East South Central, 7% of the West North Central, 4½% of the East North Central, 2½% of the West South Central, and 1% of the Middle Atlantic and the South Atlantic.

Pick-up sweepers are next in popularity, being found in 22% of the Pacific, 7½% of the Mountain, 6% of the South Atlantic, 5% of the East South Central; 4% of the West North Central and West South Central, and 3% of the East North Central.

Tractor-sweepers, which are especially popular in Florida, were reported by 8½% of the South Atlantic municipalities, and by 1% of those in the Middle Atlantic, East North Central and West North Central.

Power sweepers were reported by 2½% of the East South Central, 2% of the East North Central and Middle Atlantic, and 1% of the South Atlantic and West North Central.

Stated in another way, horse-drawn rotary brooms are the most common equipment in the small municipalities of New England, Middle Atlantic, South Atlantic, East North Central, West North Central, and West South Central districts; flushers in the East South Central and the Mountain district; and pick-up sweepers in the Pacific district.

Information was obtained also concerning frequency of cleaning the principal streets in the several communities. Nineteen and one-half per cent of the 1,000 communities did no street cleaning, 15% cleaned "when necessary," "at intervals," or gave no definite information on this point.

Of the others, 37% cleaned once a week, 31% daily, 13% twice a week, 7% once a month, 6% twice a month, 4% three times a week, and 2% four times a year. If we consider that cleaning at least once a week is necessary for reasonable cleanliness, we find that 56% of all of these small communities reporting, clean their principal streets at least that often.

Industrial Water from Sewage

Plant at Grand Canyon National Park using pre-settling, activated sludge, rapid sand filters and sterilization, produces effluent used for boilers, irrigating lawns and flushing toilets.

At the Grand Canyon National Park a sewage treatment plant has for almost two years been producing a sewage effluent of the same quality as drinking water insofar as bacteriological results are concerned, and of better quality than the original water for generating steam. The conditions which call for such treatment are unusual but no means unique and it seems probable that the same procedure could be adopted in many other places in arid sections of the country to financial advantage.

Most of the visitors to the Grand Canyon have gone to the south rim, where there are hotels, stores, and an automobile camp. The water supply for this settlement is furnished by the Santa Fe Railroad company, which hauls it in tank cars from Flagstaff, Arizona, a distance of about 100 miles; or, when this becomes low, from Puro, Arizona, about 120 miles. The cost of bringing the water from Flagstaff is \$3.09 per thousand gallons, and the amount delivered during the tourist season, when there are approximately 2,400 people in the park, averages about 100,000 gallons daily.

The only sources of supply in the territory around the south rim are the San Francisco Mountains, about 52 miles away; Bright Angel Creek, about six miles away and 5,000 feet lower elevation; some springs about two miles away and 3,500 feet below the rim of the canyon; and the Colorado river. The cost of the first two would be excessive; the Colorado river has very high turbidity during most of the year and the necessary lift of 5,000 feet through 6 miles of pipe is a drawback; and the spring supply has been under litigation.

When the Santa Fe railroad began developments here it built a sewage treatment plant consisting of septic tanks, contact filters, and pressure sand filter, with a view to using the effluent for irrigating lawns and for boiler purpose. However, the effluent was always putrescible, containing hydrogen sulphide, and could not be used for irrigating lawns near the hotel on account of odors, and was not satisfactory for boiler purposes. The laundry waste caused foaming in boilers and was by-passed around the plant.

In 1924 the number of visitors to the park had increased to such an extent that the problem of supplying water for them all was acute, and it was decided to endeavor to treat the sewage so that it could be used for many purposes in place of fresh water. A plant built for this purpose was put into service in June 1926 and has been operating since then. It is described by H. B. Hommon, sanitary engineer with the U. S. Public Health Service, in "Public Health Reports," to which we are indebted for the following descriptions and illustrations.

Settling tanks, slow sand filters, and sterilization were considered and would have produced a satisfactory effluent, but the high cost of sand (approx-

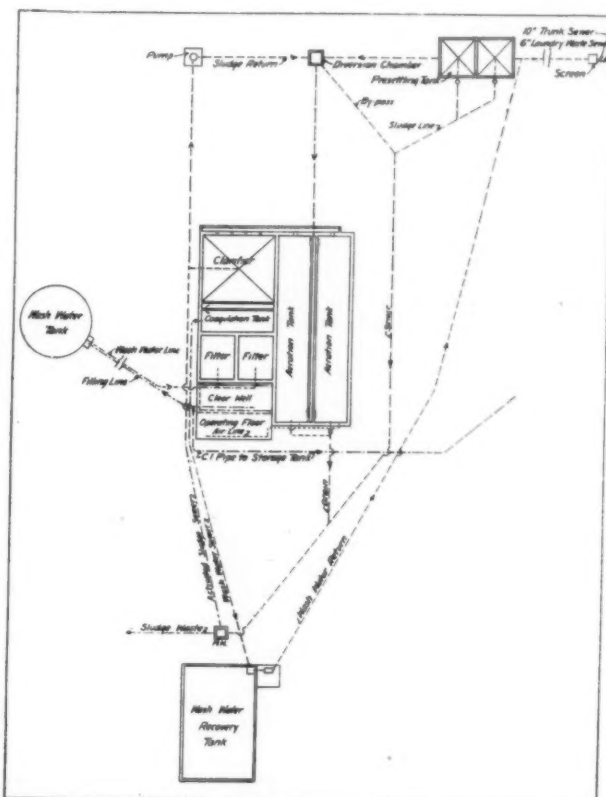
imately \$7.00 per yard) and the difficulty of operation during winter at an elevation of 6,800 feet made it seem impracticable. The high cost of materials and severe winter weather precluded the adoption of sprinkling filters also. It was therefore decided to adopt the activated sludge process, rapid sand filters and sterilization. The plant which was built, embodying these features, is described below.

Just above the presettling tank is a coarse bar screen three feet wide by three feet deep constructed of $\frac{3}{8}$ -inch by 2-inch rectangular iron bars spaced $2\frac{3}{8}$ inches on centers.

A presettling tank was designed for a detention period of 30 minutes at the time of maximum flow. It has hopper bottoms and the sludge is discharged by gravity into a bypass around the plant. It has two sewage outlet pipes, one of which is level with the top of the hoppers and leads to the aeration tank, while the other is near the top of the tank and connects with the lower pipe.

A small diversion chamber is located on the line from the presettling tank to the aeration tank for the purpose of bypassing the sewage around the treatment plant when necessary.

There are two aeration tanks, each 42 by 8 by 10 feet deep below water level, designed to treat approximately 200,000 gallons of sewage daily with



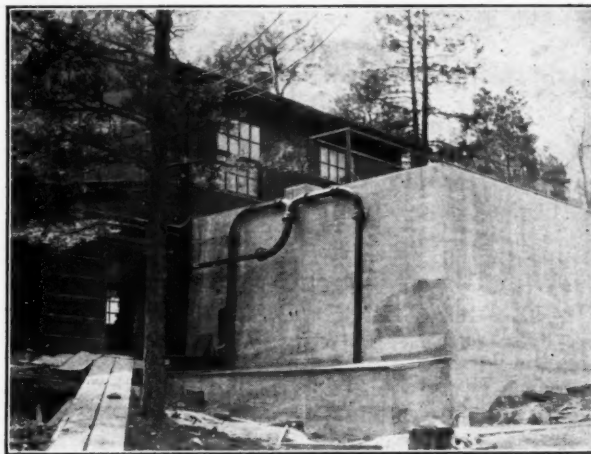
GENERAL LAYOUT OF SEWAGE TREATMENT PLANT.



GENERAL VIEW OF GRAND CANYON PLANT

1. Wash water return line.
2. Presettling tank.
3. Diversion chamber.
4. Valve on line from air channel.
5. Aeration tanks.
6. Clarifier.
7. House over sand filters, clear well, pumps and motors.

an average aeration period of 6 hours. In each tank are two continuous concrete air channels, 11 inches wide by $5\frac{1}{2}$ inches deep covered with 12 by 12 by $1\frac{1}{2}$ inch filtros plates which were grouted into the top of the sidewalls of the channel and into T-irons across the channels. The air channels at both ends of the tank have 4-inch pipes that extend through the concrete walls about two feet, and on the end of each pipe there is a four-inch gate valve; these pipes being for the purpose of blowing out the sewage that accumulates in the air channels when the plant has been closed down, and to permit cleaning the under-surfaces of the plates if they should become clogged. The air is applied to the



END OF AERATION TANKS

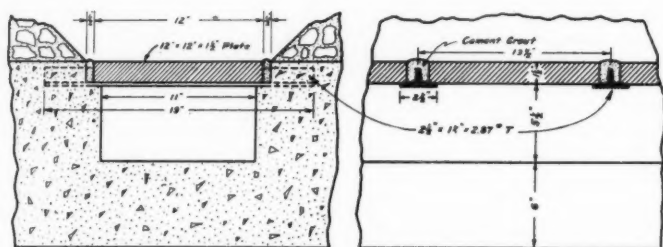
Shows air supply pipes to channels under Filtros plates

4-inch pipe at the ends of the tanks nearest the blowers, as shown in the illustration. At the opposite ends, 2-inch pipes connected to the 4-inch pipes just outside the wall of the tank lead upward and into the tank in order that the sewage which is blown out of the air passages, as described before, can be blown back into the tanks again.

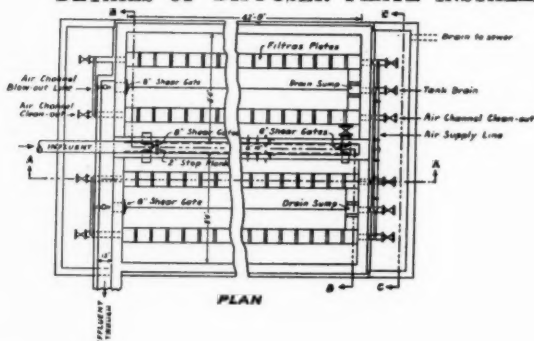
The clarifier tank is 16 feet square and $11\frac{1}{2}$ feet deep and is provided with a scraping device that concentrates the sludge at an outlet pipe in the center. It has a detention period of approximately 2.8 hours with the present sewage flow, assuming that most of the sewage reaches the plant during 14 hours.

A tank 16 feet by 4 feet by 10 feet deep was originally designed as a coagulation basin to be used in connection with the operation of the rapid sand filters. It was found, however, that it was not necessary to use coagulents and this tank has been used as a secondary settling tank. An appreciable amount of solids is removed by this tank and the sludge is discharged through one-inch openings placed one foot apart in an 8-inch pipe which extends the full length of the bottom of the tank.

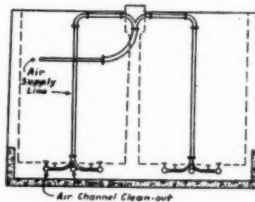
Two rapid sand filters were constructed, each having an area of 77 square feet. In the bottom of the filters were placed 8 inches of gravel between $2\frac{1}{2}$ -inch and $1\frac{1}{2}$ -inch mesh, 4 inches between $1\frac{1}{2}$ -inch and $\frac{3}{4}$ -inch; 4 inches between $\frac{3}{4}$ -inch and $\frac{1}{4}$ -inch, and 4 inches passing $\frac{1}{4}$ -inch and retained on $\frac{1}{12}$ inch. On top of this was placed the filtering sand. Sand was ordered having an effective size of 0.35 m.m. and a uniformity coeffi-



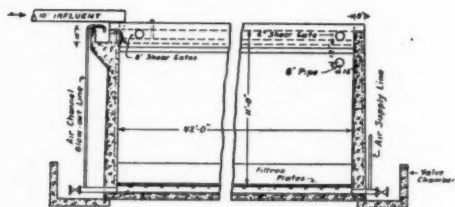
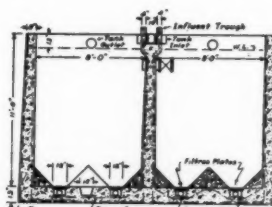
DETAILS OF DIFFUSER PLATE INSTALLATION



PLAN



SECTION C-C

SECTION A-A
PLAN AND SECTIONS OF AERATION TANKS

SECTION B-B

cient of 1.6 for one filter, and sand with an effective size of 0.40 m.m. and a uniformity coefficient of 1.6 for the other filter. Through a mistake of delivery, however, the effective sizes were 0.34 and 0.23 m.m. respectively, with uniformity coefficients of 1.29 and 1.48.

Part of the reclaimed sewage is forced into a wash water tank, from which an 8 inch pipe supplies wash water for the filters.

A clear well 16 feet square and $5\frac{1}{2}$ feet deep below the overflow, with a capacity of 10,500 gallons, was provided; although in practice the automatic floats start the pumps in operation when the sewage reaches about 1 foot below the overflow.

The reclaimed sewage is pumped to a steel storage tank by two 4-inch vertical centrifugal pumps operated by vertical motors. The storage tank has a capacity of 200,000 gallons.

There are two air compressors, each with a capacity of 200 cubic feet per minute.

A semi-automatic chlorine machine is used for applying liquid chlorine to the reclaimed sewage. When either of the pumps starts operating, the force of the current in the main moves a vane hanging in the line, and this in turn opens a valve of the chlorine machine which permits chlorine dissolved in water to flow into the clear well at the combined suction of the pumps. When the pumps stop operating, the vane falls back to a vertical position and shuts off the chlorine. There is also provided for an emergency, standard equipment for using sodium hypochloride and a solution of this is kept on hand in 5-gallon jugs.

A settling tank 25 feet by 16 feet by $4\frac{1}{2}$ feet deep, with a capacity of 13,500 gallons, is provided for collecting the wash water from the filters, from which it is pumped back to the presettling tank at a low rate over a period of several hours.

OPERATING DATA

At first the floc did not settle out in the clarifier and the filters clogged quickly; but after two months a floc developed which settled in the clarifier, and since then there has been no trouble of a serious nature in operating the plant.

The only sewage lost is that mixed with the sludge drawn off from the presettling tank (600 gallons daily) and the activated sludge that accumulates in excess of the amount required for the operation of the aeration tanks. The total volume of activated sludge wasted per month on the average is about 20,000 gallons. From the first of May, 1927, to the end of November, 1927, 98.5% of the sewage was reclaimed; and since December the laundry waste, amounting to 7,000 gallons daily during the winter and 10,000 gallons in the summer, has been mixed with the sewage and recovered, and at present the amount of sewage reclaimed approaches very closely to 99% of all the water discharged into the sewers.

An operator is in charge of the plant from 7 in the morning until 10 at night. Just before 10 p.m. the sewage in the presettling tank is drawn down to the hoppers and the sludge wasted, and the clear well is pumped out. The blower and aeration tanks operate throughout the night, but generally there is not enough sewage flowing between 10 p.m. and 7 a.m. to fill the presettling tank and clear well.

When the blower is closed down, sewage filters through the Filtros plates and fills the air channels. When the air is turned out again, the valves on the two-inch blow-out line are opened and the sewage is blown through them back into the tank. By this method of operation, no sewage is forced back through the plates. (Sewage can, however, be blown back through the plates, and this has been done.) It requires less than one minute to clean the channels of sewage after the air pressure has been turned into them.

The initial air pressure on the channels was five pounds per square inch, and after operation of the plant for almost two years it is only $5\frac{1}{2}$ pounds. The average amount of air used, approximately 4.6 cubic feet per gallon, was no doubt more than was required, but it was the normal output of the blower and there would have been no economy in reducing the volume. The aeration period, about $11\frac{1}{2}$ hours, was longer than necessary to produce a satisfactory floc and stable effluent, but the tank capacity was available and it seemed advisable to use it. It is believed that the present tank and one blower will treat twice the volume of sewage now received at the plant.

An excess of about 0.5 parts per million of chlorine has been carried in the force main at all times to insure complete sterilization of the reclaimed sewage in the storage tank.

It has been found that the aeration tanks give most satisfactory results when they contain about 25% of activated sludge. Sludge is returned to the diversion chamber ahead of the aeration tank by an airlift. Originally a low-lift screw type of pump was used for this, but on account of excessive wear of the bearings an airlift was substituted.

CHEMICAL AND BACTERIOLOGICAL RESULTS

A complete chemical laboratory was installed in April, 1927, and bacteriological results have been made weekly since January 1, 1928.

Mr. Hommon compares the results obtained at this plant with the average of the fifteen plants which were analyzed in "Public Health Bulletin" No. 132 (see PUBLIC WORKS for September, 1922). The sewage at the canyon was much stronger than the average for these cities, the settleable solids being 278%, suspended matter 23%, and oxygen demand 232% stronger than such averages. In the effluent from the sand filter plant at the canyon, the suspended matter was consistently below 5 parts per million, the nitrates were high, and the oxygen demand was below two parts per million. The oxygen demand of the effluents of the aeration tanks and clarifier was likewise uniformly less than two parts per million. The dissolved oxygen was low (3.2 to 5.0 p.p.m.), which is explained in part by the fact that at the elevation of the treatment plant, 6,866 feet, the solubility of oxygen in water is about 30% less than at sea level. The relative stability of the effluents from the filters and clarifier, by the methylene blue test, was in every analysis more than 90%.

In Public Health Bulletin No. 132, page 13, Table No. 6, there are given the changes in the alkalinity of different sewages on passing through oxidizing devices. The sprinkling filters at Fitchburg reduced the alkalinity from 99 to 8 parts per million; those

at Baltimore, 144 to 63; Reading, Pa., 177 to 105; Rochester (Brighton plant), 189 to 131; Lexington 194 to 152; Atlanta (Intrenchment Creek plant), 82 to 48; Atlanta (Peachtree plant), 69 to 35; and Columbus, 219 to 192. The contact filters at Alliance reduced the alkalinity from 194 to 167, while similar filters at Canton showed an increase of 11 parts per million. The activated sludge plant at Houston (south side) reduced the alkalinity from 304 to 220, and the north side plant, 270 to 198; at San Marcos, Tex., the reduction was from 311 to 239; and at Sherman, Tex., the alkalinity of the effluent was 416, and of the sewage, 415. The reduction of the alkalinity in each plant was almost directly in proportion to the degree of purification effected. At Fitchburg, for example, where 92 per cent of alkalinity of the sewage was removed by the sprinkling filters, the nitrification was higher and the oxygen demand lower than at any of the other filter plants. The effluent from the activated sludge plant at Sherman, Tex., which was the poorest of all the effluents examined from activated sludge plants, had practically the same alkalinity as the raw sewage. The plant at the Grand Canyon removed 86 per cent of the alkalinity before the laundry waste was treated with the sewage, and 80 per cent afterwards.

In view of the fact that the oxidizing processes of sewage-treatment plants, when producing a high quality of effluent, reduce the alkalinity somewhat in proportion to the extent of oxidation of the organic matter, it is but reasonable to assume that the reduction is associated with the biological activity of the oxidizing devices. This relation, if better understood, might possibly throw more light on the problem of sewage treatment.

The pH value of the raw sewage and activated sludge at the canyon averages 7.0, and the final effluent, 6.3.

Bacteriological analyses made since the first of this year show that 99.98% of the bacteria in sewage growing on agar at 37 degrees were removed by the treatment plant, and that 99.84% of the *B. coli* in the raw sewage were removed by the aeration tanks and clarifier and 99.99% by the plant as a whole. Out of the 70 portions of 10 c.c. samples of the sterilized effluent analyzed, only one was positive for *B. coli*. Since June 1926 there have been 55 analyses of 5 portions each of the sterilized effluents from the force main, and of these only 12 portions or 4.4% were positive for *B. coli*.

RECOVERY OF LAUNDRY WASTE

When the sewage without the laundry waste was being treated satisfactorily, it was decided to investigate whether this waste also could not be treated and the water recovered. Analyses showed that the hardness of the laundry waste was due to carbonates and bicarbonates, and 86% of these constituents were removed from the sewage in the treatment plant, and therefore it was not considered necessary to treat the waste and it has been mixed with the sewage since December, 1927. The total hardness of the effluent from the combined sewage and waste varied from a minimum of 23 to a maximum of 37 parts per million, with an average of 34, which was slightly above that for treated sewage before the laundry waste was added.

USE OF RECLAIMED SEWAGE

At the present time the reclaimed sewage is used in stationary boilers for generating steam for heating purposes, and in the locomotives that haul passengers and freight trains on the branch line of the Santa Fe from Williams to the Canyon; for cooling water for Diesel engines; for irrigating lawns around the hotel, and for flushing toilets in the public comfort stations in the El Tovar Hotel, Bright Angel Camp, railroad depot and government automobile camp.

Quite elaborate precautions have been taken to insure that none of the reclaimed sewage would be used for any purpose other than those named.

The locomotive engineers at first vigorously opposed the use of "sewage" in passenger engines, but after a demonstration by an expert engineer they used the reclaimed sewage and found that it produced less scale than the fresh water obtained at the canyon.

COST OF OPERATION

The average volume of sewage reclaimed daily during 1927 was 79,000 gallons, and the itemized cost of treatment per 1,000 gallons was approximately as follows

Electric current at 5c per kilowatt:	
Operating blower	\$0.20
Returning wash water .....	.003
Operating clarifier .....	.01
Lighting .....	.003
Labor for operating plant:	
2 operators and sanitary engineer.....	.177
Liquid chlorine, oil, grease, repairs to equipment, and extra labor .....	.009
Interest on investment* (treatment plant only)....	.086
Depreciation* (treatment plant only).....	.086
	<hr/>
	.574

These costs would be reduced approximately one-half if the plant were operating at the capacity for which it was designed and if electric current were available at the commercial rate charged in cities; and the labor cost would decrease materially for plants treating large volumes of sewage.

Mr. Hommon expresses the belief that "where there is a scarcity of water, particularly in the west and southwest, it will be economically practicable to reclaim sewage for industrial purposes, and for irrigating any kinds of crops without danger of contaminating ground water or the products grown. The same degree of purification, however, will not be required for sewage to be used for irrigation as for industrial purposes, but sterilization will be necessary for reclaiming sewage used in growing vegetables and some other crops. The cost per acre-foot for sterilizing a well oxidized effluent such as that produced by an activated sludge plant will be approximately \$1.20 for small treatment plants using small cylinders of chlorine, and 60c. for large plants using one-ton containers. Where sewage is reclaimed for industrial purposes or for irrigation, a part of the operating expenses should logically be charged against the municipalities for disposal of the sewage, and the remainder paid by the parties benefitting by the use of the reclaimed sewage."

The plant of the Canyon was designed by H. B. Hommon, assisted by L. D. Mars, formerly as-

*Estimates, but believed correct within 2 cents per 1,000 gallons.

sistant sanitary engineer, U. S. Public Health Service; M. R. Tillotson, formerly civil engineer of the park and now superintendent; and G. L. Davenport, assistant engineer, Santa Fe Railroad Company. The plant was built jointly by the Government and the railroad company. J. R. Eakin, formerly superintendent of the park, had general supervision over the part built by the Government, with Mr. Tillotson in active charge of construction, and the work done by the Santa Fe was under the general supervision of R. B. Ball, chief engineer of coast lines, and G. L. Davenport, assistant engineer.

The plant was operated for one month at the start by Frank R. Shaw, associate sanitary engineer, U. S. Public Health Service, who was succeeded by Dario Travaini, who is now in charge.

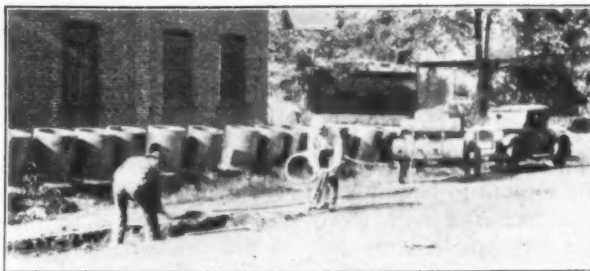
Sewer Construction in Montclair

Montclair, N. J., obtained a general plan for a sewerage system and began constructing same nearly forty years ago. Like many other towns which built sewers prior to the past ten years, experience has shown that there is considerable leakage of ground water into these sewers, which it is now impracticable to stop without discontinuing the use of them. In at least one instance, leaky joints in a sewer flowing under a pressure head due to inability to carry the excessive infiltration of groundwater up the line has resulted in collapse of the sewer. (See PUBLIC WORKS for May, 1925). This, together with the very large growth of the town, has necessitated the building of larger sanitary sewers; and it has also taught the engineers and officials of this town (which has not been the case in every town with similar experience) that it is decidedly economical in the long run to build sewers that do not leak and that are amply strong.

One of the sanitary sewers now being built by the town is a 24-inch line laid in a trench from twenty-three to ten feet deep, which passes under the tracks of the Erie railroad at a depth of about nineteen feet.

For about 75 or 80 feet, where the sewer line crosses under the railroad it is being built with 24-inch cast-iron pipe with Leadite joints, which was carried under the right-of-way of the railroad in a tunnel, as the company would not permit the contractor to open a trench from the surface down.

The remainder of the line is being built of 24-inch vitrified pipe, with is entirely surrounded with concrete throughout its length, there being about 6 inches under the pipe, and the concrete being carried the full width of the trench up to the level of the top of pipe. The trench is about 48 inches wide, giving about 10 inches of concrete on each side of the sewer. Where there is ground water and the clay has become more or less sloppy, about 6 inches of gravel is rammed into the clay for the entire width of the trench and the concrete around the pipe rests upon this. The joints of the vitrified pipe are made with asphalt, heated



REMOVING TELFORD PAVEMENT WITH AIR PICK.

and poured into them. The backfill is being placed in 6-inch layers, each layer well rammed.

The soil is a hard, red clay interspersed with gravel from small size to quite large, being almost of the nature of a hard pan. It stands up well, requiring only bracing about every five to ten feet, but makes very hard digging. The street was originally paved with telford macadam, and this is removed with a pneumatic pick operated by a portable Ingersoll-Rand air compressor. One man operates the pick while a second man throws the loosened paving material to one side by hand shovel.

The excavation of the trench is carried on almost entirely by these two men and a Star power shovel used as a trench machine, run by one operator. These three men can excavate the trench faster than the pipe can be laid in it; except that where there are service connections to water and gas mains, there is some delay while the soil around these is being excavated by hand. The excavating machine is using a dipper 42-inches wide and holding about three-quarters of a yard when filled, which makes a trench about 48 inches wide.

When not interfered with by rock, service connections or otherwise, the excavator will remove the dirt at an average rate of a dipperful in about a minute, down to a depth of about 19 feet. At the deepest point, 23 feet, the remaining four feet was removed by hand shoveling into a bucket, which was raised to the surface by an Austin backfilling machine used as a crane. Comparatively loose shale was removed without picking; but where a large stone or rock protruded from the trench wall, the excavation below the top of this was done by hand, the machine moving ahead and the hand-dug dirt being thrown forward to be removed by the machine. When starting a new trench or deepening one partly excavated, the dipper arm is extended to form a practically straight handle and the teeth of the dipper used as picks for breaking up the



MACHINE EXCAVATING SEWER TRENCH.

ground. The operator of this machine, R. Filkin, states that his record with this machine is 400 feet of trench 32 inches wide and 9 feet deep in 8 hours and 15 minutes, or at the rate of about 42 cubic yards per hour.

In laying the cast iron pipe under the tracks in tunnel, this tunnel was made about $5\frac{1}{2}$ feet deep, the minimum height which the men could work, and was timbered with 3x10 planks on both sides and the top, which were left in the tunnel. The iron pipes were jointed with Leadite. The tunnel was refilled with dirt thrown in by hand and then, with a strong jet of water from a hose, washed back toward the backfilling which was already in place.

This sewer is being built by Peter Scola, of Glen Ridge, N. J.



OUTFALL SEWER ON SOLID-PIER TRESTLE

Hazard of Exposed Sewers

Sewer carried on trestles was broken by trees falling on it during a hurricane.

Columbia, South Carolina, in 1918 built an outfall sewer about 7 miles long, about a mile of which was supported on trestles in order to keep it at the hydraulic gradient and avoid the disadvantages of inverted syphons. The sewer was built of 15" and 18" concrete pipe and laid on a grade of 0.2 per cent.

The accompanying illustrations show two of the different designs of trestle used for supporting the sewer.

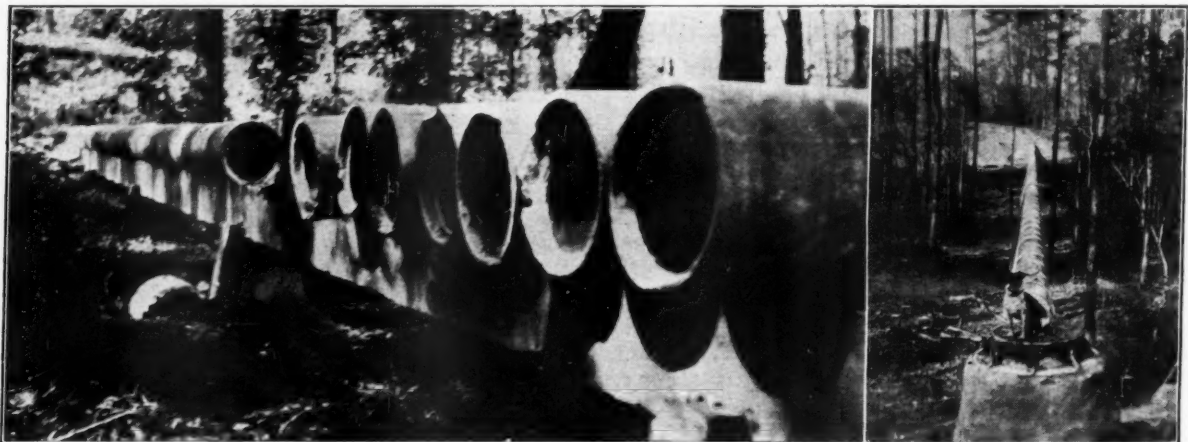
On some of the long trestles, several of the tongue-and-groove joints of the pipe have leaked where the cement mortar joints have been broken by contraction and expansion or by settlement of beams and piers which support the pipe, due to washouts, saturated ground, etc. The expansion and contraction would be natural, considering that the pipe is exposed to the heat of a southern sun and temperatures which fall below freezing in winter.

During a hurricane which visited Columbia on September 18, 1928, several large pine trees fell across the exposed pipe and crushed a number of sections, which it was therefor necessary to



OUTFALL SEWER ON OPEN PIER TRESTLE

replace as soon as possible. In making the repairs, it was necessary to remove not only the pieces which were crushed but intermediate ones in order that a continuous line of replaced pipe could be obtained, the unbroken pipe sections being relaid. This offered an opportunity for examination of the interior of the pipe, and George Nafey, plumbing inspector of Columbia, reports that the entire surface of the pipe was in perfect condition, hard and smooth, with the exception of very slight abrasion at the bottom due to the flow of grit, etc., in the sewage. The cement



PIPES REMOVED AND RELAI IN REPAIRING BREAK

PIPE LINE REPAIRED

mortar joints were perfectly hard and had to be removed with a chisel. The sewer has recently been running about one-half full of domestic and industrial sewage. It was laid by T. Keith Legare, city engineer of Columbia.

This experience illustrates the hazards of sewers laid exposed not only to the effects of temperature changes and weakening deterioration, but also to destruction by falling trees or other heavy bodies.

Some Biochemical Factors in Sewage and Sludge Treatment¹

Use of ripe sludge for seeding tanks. Effect of partially decomposed sludge.
Use of buffer solutions with lime. Enzymes and colloidal matter.

By Willem Rudolfs²

Decomposition of complex unstable organic substances in sewage and sewage sludge is dependent upon a number of factors. Some are physical, others chemical and still others biological in nature. The interdependence of these factors is well known, but even at present we are far from being able to evaluate definitely all the different factors responsible for the decomposition and stabilization of the organic substances.

RIPE SLUDGE

The function of ripe sludge, ordinarily spoken of as "seeding" or inoculating material, is in effect manifold. The organisms and their enzymes present in the sludge, the type and amount of salts, the character and quantities of colloidal matter, are among the most important factors. The value of ripe sludge in the digestion processes is generally recognized. When fresh solids are mixed with ripe sludge, the time required for practical completion of decomposition is only a fraction of the time needed when fresh solids are left alone to decompose. But we have only a more or less hazy understanding of the importance of each factor responsible for this result. Moreover, as soon as we change the physical conditions (temperature for instance) the results obtained are different.

AGE OF RIPE SLUDGE AS A FACTOR

Fresh solids seeded in proper proportions with ripe sludge digest at a temperature of 70°F in from 30 to 40 days. The proper proportions under these conditions are about in a ratio of 1:2 on a volatile matter basis; or, with domestic sewage, on the basis of dry solids as 1:1. As soon as the amounts of ripe sludge are materially decreased the length of time required to complete digestion is greater.

How old a sludge can we use for seeding? Does ripe sludge retain its seeding value indefinitely? A series of experiments were conducted to find an answer to these questions, which, from a practical standpoint, are of interest when new plants are started. Sludges used for seeding were kept from 24 hours to 8 months in storage without adding fresh solids. These ripe sludges were then used for seeding definite quantities of fresh solids in such a way that the relation between the volatile matter in the fresh and that of

the ripe sludge was kept constant (1 ripe to 2 fresh). After 30 days, when the digestion of material seeded with freshly drawn sludge was practically completed, it had produced 780 cc. gas per gram of volatile matter added as fresh solids, whereas the mixture seeded with sludge stored for 8 months had produced 182 cc. gas. Apparently little change had occurred in the sludges stored up to 2 months since the time required for digestion of the mixtures was not appreciably different from that drawn freshly. It appears thus that the ripe sludge does not retain its seeding value indefinitely and should not be older than 2 or 3 months.

Offhand it would seem that the organisms responsible for gas production disappear when the available food supply is practically exhausted. The available food supply is apparently only a part of the total organic matter, since about 50% of the original organic matter is left as ripe sludge. We have shown that during the digestion processes the total numbers of organisms decrease. When sludge is ready to draw, it may contain up to 45 millions of bacteria, while after a storage of two years about half a million organisms are left, although the sludge still contains 47% volatile matter.

STAGE OF DECOMPOSITION AND SEEDING

A partially decomposed material is poor for seeding purposes. Yet such material may contain more organisms per cc. or per gram of dry material than does ripe sludge, it may have as high or higher alkalinity (carbonates and ammonia), and may contain more colloidal substances than the ripe sludge. We know that the organisms responsible for the destruction of organic matter are present in the fresh solids, because eventually the material decomposes, but it takes much longer than when fresh solids are mixed with ripe sludge. It seems logical therefore to conclude that certain groups of organisms and their enzymes are responsible for the decomposition, rather than the flora as a whole. If it is a question of sufficient number of certain species, it might be expected that sludge in the process of decomposition acts differently at different stages. In a series of experiments where fresh solids were mixed with ripe sludge, some received in addition inoculum taken from material at different stages of digestion. The results showed that the additional inoculum

¹Journal Series paper of the New Jersey Agricultural Experiment Station, Dept. of Sewage Disposal.

²Chief, Dept. of Sewage Disposal, New Jersey Agricultural Experiment Station.

taken from the material in progress of digestion for a few days had no effect upon the rate of gas production but when material was used from mixtures at the peak of gassification, the rate of gassification was increased persistently.

BUFFER ACTION

The object in liming sewage solids is to make or keep the environmental conditions such as to conform to the optimum for biological activities. The question has been raised again and again whether other chemicals than lime would not function better. The addition of lime to actively digesting material has the tendency to increase the activities of the organisms, with the result that more acidic materials are produced and consequently again and again lime must be added. Both in the laboratory and in practical operation it is very difficult to keep the reaction of the material at the required optimum.

It was recognized early in our studies that the question of proper buffering was important. A few results will show what can be expected. For comparison are selected (1) fresh solids without reaction control, (2) reaction controlled with lime and (3) reaction controlled with lime and a buffer solution. Unseeded fresh solids were used. With lime alone the reaction was maintained at pH 7.3, and in the third case the reaction was changed from 5.6 to 7.0 with lime and from 7.0 to 7.3 with a buffer solution consisting of $\text{NH}_3\text{-HCO}_3$, $(\text{NH}_3)\text{CO}_3$ and K_2HPO_4 .

After 33 days digestion the percentages of volatile matter reduction were as follows (unseeded material):

- | | |
|-----------------------------|-------|
| 1. No reaction control..... | 13.5% |
| 2. Lime only | 19.7% |
| 3. Lime and buffer..... | 24.8% |

In addition to the greater volatile matter destruction, the material treated with lime and buffer solution had to be adjusted only once, whereas with lime alone the reaction had to be adjusted constantly. Such a reaction adjustment has special value when new tanks are put into operation.

ENZYMES

It is well known that enzymes are present in crude sewage and are presumed to convert the high molecular suspended and pseudo-colloidal matter into liquids. The types present and their variations in abundance during digestion have been under investigation in our laboratory. Of the enzymes present might be mentioned particularly: Diastase, lipase, pepsin, trypsin, catalase, invertase and rennet. Some of them increase rapidly and then decrease before others have reached their maximum, although some amount of each of them is present at all times. Naturally, some of the enzymes are most abundant during the first stage of digestion. Results on the effect of adding certain enzymes in small quantities will be published eventually.

COLLOIDAL MATTER

Most of the finely divided material—pseudo-

colloidal and true colloidal—reaching a settling tank, passes out, or if partially attacked in the comparatively short retention time, is replaced by similar matter emerging from the underlying sludge. In a digestion tank the amount of colloidal matter is considerably greater. Desintegration and biological activities cause the formation of colloidal material which is then more easily attacked by bacteria and their enzymes. When certain biological activities are overbalancing, the supernatant liquid becomes dense, the viscosity is increased, the surface tension is changed and the stage is set for difficulties. Flocking out the super-abundance of finely divided material (with lime for instance) helps to avoid troubles. If a mass of digesting material is left alone, the amount of colloidal material increases and eventually decreases. While these changes are in progress the chemical composition of the colloidal matter changes, not only on account of enzyme action, but also because of the nature of the components of the sludge.

SUMMARY

The complexity of unstable organic substances in sewage and sewage sludge results in a variety of degradation products, which are affected by biological, chemical and physical factors and also affect each other. Ripe sludge does not retain its inoculation value indefinitely, in spite of the fact that buffering conditions are maintained, because suitable food material for bacteriological activities disappear. A favorable reaction is important for biological activities, which can be assisted materially by suitable buffer solutions. Enzymes which are always present in sewage and sludge, converting colloidal and pseudo-colloidal matter into liquid, vary in type and abundance during digestion. The same holds for these finely divided materials themselves. The interdependence of the biochemical factors mentioned is apparent.

Excluding Inflammable Oils from Baltimore Sewers

By C. E. Keefer*

One of the hazards accompanying the wide-spread use of automobiles has been the danger caused by the presence of spent crank-case oils and gasoline in the sewers of a number of the municipalities in this country. The damages caused in many cities by the ignition of these materials in the sewers have frequently been considerable.

Until the summer of 1926 Baltimore was fortunate in never having had a fire or explosion in its sewerage system. There were a number of reasons for this good record. In the first place, the sanitary sewers and the storm drains have sufficiently steep grades so that the velocities are high with little or no stagnation of sewage or storm water. Moreover,

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the sewers are well ventilated and allow the escape of inflammable gases. Furthermore, floor drains from garages are not permitted to be connected with the sanitary sewers, but must discharge on the surface or into a storm drain. This practice minimizes the possibility of fires in the sanitary sewers. The odor of gasoline, however, is frequently prevalent in those sewers which serve sections of the city where there are a large number of garages. Furthermore, oil has been detected in several of the large drains which flow through the city.

A full appreciation of the threatening danger was not fully realized until an explosion, which was followed by a fire, took place on June 8, 1926 near the mouth of the Jones Falls conduit, the largest storm drain in the city. The fire was caused by someone throwing a lighted match into the open stream at the mouth of the conduit. Oil and gasoline on the water immediately ignited, and the surface of the stream for a distance of a block was covered with flames, which leaped 50 ft. into the air. The fire extended into the conduit, and was followed by explosions, which occurred for a distance of a mile above the mouth of the drain. Manhole covers were blown off, and the front of one building was stripped of woodwork and glass. Smoke and fumes backed up through storm drains into many buildings, and caused increased excitement. A theatre adjacent to the mouth of the conduit caught fire, but fortunately no serious damage resulted. The blazing oil floated downstream, and ignited a bridge. Luckily, there was little wind at the time, and the flames were soon checked.

Immediately after the fire, a thorough investigation was made by the city officials to find the source of the oil. The conduit in which the fire took place, together with its outlet, was carefully watched. On numerous occasions oil was observed. But the task of finding where it came from was practically hopeless.

It seemed apparent that until some method of disposing of the oil was provided, many garage owners would continue to dump the oil into the sewers and the drains whenever possible. An ordinance which provided for the storage and disposal of this material was finally adopted, of which the following are some of the more important provisions:

1. All waste oils, including crank-case drainings, shall be immediately taken up and deposited and kept while on the premises in steel drums, the character, size, construction, number and location of which shall be from time to time prescribed by the Board of Fire Commissioners of Baltimore City; or in containers of other construction approved by the Chief Engineer of Baltimore and by the said Board.
2. All waste greases shall be collected at least once daily and deposited and kept as in the manner provided for waste oils. . . . and in no case shall any waste greases be permitted to remain in or about any premises over night, except when so deposited.
3. The Mayor and City Council, acting through the Chief Engineer of Baltimore, shall determine from time to time the agencies by or through which all such drums, containers and/or the contents thereof shall be removed, stored, transported and disposed of; and the times when, the places where and the manner in which the same shall be done; and such determinations shall be subject to the approval of the Board of Fire Commissioners of Baltimore City; and no such drums, containers and/or contents shall be removed, stored, transported or disposed of in any other manner or through any other agency.

The last of the above provisions gave the city

officials the authority to decide who would collect and dispose of the oils and greases. A two-year contract, beginning in September 1927, was accordingly made with a private company for the collection and the disposal of the above materials. For this service the contractor receives \$3,240 a year in quarterly payments. He is required to furnish containers for the storage of the oil where the quantity exceeds 20 gal. a week. Where smaller quantities are collected, the occupant of the premises has to provide his own container. When the drums are filled, they must be removed within 24 hours. The contractor uses three trucks for carting away the oil. Each truck is provided with a tank having a capacity of about 450 gallons, into which the oil is pumped. From 1,000 to 1,500 gallons of oil are collected daily. It is then disposed of by refining.

The enforcing of the ordinances covering the collection of the oils and their unlawful disposal into the sewers is under the jurisdiction of C. F. Goob, chief engineer of the Department of Public Works, and under the immediate supervision of C. K. Allen, engineer of street cleaning, and M. J. Ruark, sewerage engineer. Although the sewers and drains are not yet entirely free from gasoline and oils, conditions are considerably better than they formerly were.

Curing Concrete Pavements

Tests by U. S. Bureau of Public Roads
of sodium silicate and calcium chloride
as substitute for water curing.

It has been found extremely difficult to secure complete enforcement of the ordinary specifications for water curing on the average job of concrete road construction. There is also the disadvantage that water curing requires an expensive line of water pipe, and an inspector constantly on the job to see that the pavement is kept wet for a specified period. These facts have been advanced as arguments in favor of using materials for artificially curing concrete which require no attention after the initial treatment and are claimed to be just as effective as the usual wet method.

During the summer and fall of 1926, the Maryland State Roads Commission, in cooperation with the U. S. Bureau of Public Roads, began field experiments for the purpose of obtaining data regarding the use of sodium silicate and calcium chloride as substitutes for wet earth in curing concrete pavements. After these pavements had been in service nearly two years, the entire experiment was reported upon by F. H. Jackson, engineer of tests, and George Werner, senior scientific aid, of the Division of Tests of the Bureau of Public Roads. The following is a brief abstract of this report:

The test was made on two sections of the Crain highway in Maryland, each about two and a half miles long and divided into three subsections of approximately equal lengths, one of which was cured by means of wet earth, one by means of sodium sili-



APPLYING SODIUM SILICATE SOLUTION TO SURFACE.

cate and one by means of calcium chloride. One section was built during May to September, the other during October and November.

The concrete was approximately a 1-2-4-mix. The aggregate consisted of a rather fine sand which ran very uniform throughout the construction, and a coarse aggregate of river gravel, which ranged between $\frac{1}{4}$ " and $3\frac{1}{2}$ " in the first section and varied considerably from stock pile to stock pile; and between $\frac{1}{4}$ " and 2" in the second section.

In curing with wet earth, as soon after finishing as possible, the concrete was covered with wet burlap, which was sprinkled if necessary and allowed to remain in place until the following day, when it was removed and the pavement immediately covered with two inches of earth, which was kept continuously wet for seven days, and finally removed after 21 days.

In the use of sodium silicate, wet burlap was applied as above and the next morning it was removed and the sodium silicate applied. The manufacturer's suggestions regarding the use of sodium silicate were followed, and for this experiment a commercial 42.5° Baumé product was furnished having a nominal soda silicate ratio of 1 to 3.25.



MIXER EQUIPPED WITH A DEVICE BUILT BY CONTRACTOR FOR CHARGING EACH BATCH WITH CORRECT AMOUNT OF CALCIUM CHLORIDE SOLUTION.

A solution of 3 parts sodium silicate to one part water was prepared by thorough mixing in a barrel, and this was spread upon the concrete and squeegeed over the surface with soft-fiber brooms. The solution was applied at the rate of one pound of concentrated solution to one square yard of pavement surface.

Calcium chloride was applied at the rate of two pounds of 75% flake calcium chloride per sack of cement, mixed integrally with the concrete, a device being used for measuring the required amount of calcium chloride solution and charging it into the mixture at the time the water was added. Wet burlap was applied to the finished surface as soon as possible and removed the following day, but no further curing treatment was given.

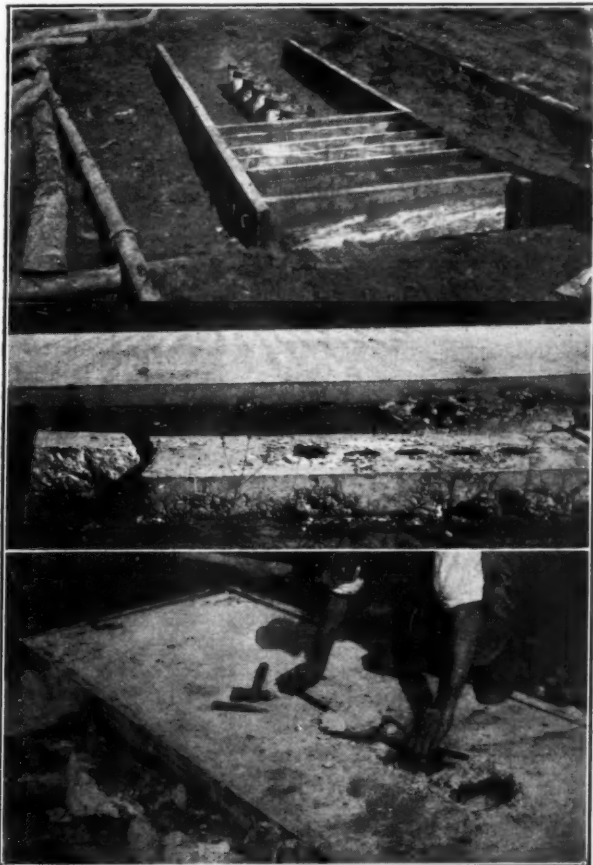
Cylinders and beams were constructed at intervals along the road from the regular mixtures and cured in the same way as the pavement proper. Instead of casting these by themselves, slabs 3' x 12' by 8" deep were cast directly from the mixer but off the roadbed proper, being placed about 3 ft. from the edge of the pavement. In general, seven slabs were cast for each subsection. Before filling the wooden forms for a slab, the sub-grade was tamped and wet down and then finished to a constant depth of 8 in. Six cylinders were cast in each slab, the mold for a test cylinder consisting of two parts—an inner slotted wrought-iron shell $\frac{1}{4}$ inch thick having an inside diameter of approximately 6 in. and a length of 8 in., and an outer loosely fitting galvanized 20-gauge sheet metal shell 10 in. long. After assembling the two parts of the molds, they were placed upright on the sub-grade within the forms and approximately on the longitudinal center line of the slab. The top of the inner shell was placed $\frac{1}{4}$ in. below the level of the top of the form and $\frac{1}{2}$ in. above the top of the sheet-metal shell, which was driven about $\frac{3}{4}$ in. into the sub-grade. A coating of heavy grease between the two molds facilitated removal of the iron cylinder, and a layer of grease at the top of the outer mold sealed the space between the two, preventing any leakage of mortar which would have made removal difficult. Test beams were made 6" by 6" by 36" long.

Concrete was discharged directly from the paving bucket into the form. Two methods of filling the cylinder molds were used. On the first section, the molds were filled in two layers, each layer being rodded twenty-five times. Those of the second section were filled in one operation and rodded twenty-five times. The beams were made in two layers, each layer rodded twenty-five times. Testing slabs were cured in exactly the same manner as the adjacent pavement. In removing a cylinder, the concrete was chiseled away around the top of the iron mold and the mold and the enclosed cylinder pried out with two pinch bars.

The cylinders were tested for compressive strength and the beams tested in cross-bending as cantilevers, two breaks being made on each beam. The results of the compression tests of the cylinders indicate very little difference in the average strength of the concrete cured by the three methods, except that on both test sections the concrete cured with calcium chloride showed somewhat higher results in compression than the concrete cured by either of

the other two methods. In the first section, this difference is only apparent during the first three days, whereas in the case of the second section an increase may be observed throughout the entire period. However, no appreciable difference was found in the transverse strength which may be attributed to the curing method used.

Data, however, for various ages up to 29 days show marked variations in strength between individual specimens of the same age but cast on different days. This might be due to two principal factors: (1) variations in temperature and humidity condi-



TOP: FORMS FOR CASTING TEST BEAMS AND SLAB

MIDDLE: SLAB AFTER REMOVAL OF FORMS

BOTTOM: REMOVING CYLINDERS FROM TEST SLAB

tions during and immediately subsequent to placing; and (2) variations in the water content of the concrete. The authors believe that the principal variations in strength are due to variations in the water content of the concrete, several conditions connected with the work having made it difficult to maintain the same water content in all batches.

Tests were made of cores drilled from the pavement after it had set for some time, and these may be considered as substantiating in general the conclusion that, in so far as strength is concerned, the three methods of curing give essentially the same results.

A survey was made of the cracking which occurred in the pavement and it was found that most of the transverse cracking which occurred in the first eighteen months took place within a few weeks after the construction. With the exception of the

wet earth sub-section of Section 1, the average spacing of transverse cracks was about the same for all methods of curing.

Concerning the present condition of the surface of the first section, the authors state that "there is considerable thin surface scale on the first sodium silicate section, which appeared a few days after the construction of the pavement, and which has apparently progressed very little beyond the initial stage. This scale has been attributed to excess water on the burlap cover, caused probably by sudden showers during construction. It is confined largely to sections constructed on days when it was necessary to shut down because of rain. This surface scale does not appear on the second sodium silicate section, which was cured in exactly the same manner as the first section, which leads to the assumption that, whatever the cause, it was probably not due to the silicate.

"Both of the calcium chloride sections show considerable surface wear and scale. In spots the thin mortar surface which remained after finishing has worn completely away. This condition is believed to be due to difficulties encountered by a crew inexperienced in the use of concrete containing a calcium chloride admixture. The re-working of a surface which had slightly stiffened up might conceivably produce a thin, weak top, which would readily scale off under traffic, producing a rather unsightly surface. It is not felt that this condition should be construed as a general indictment of the use of calcium chloride as an admixture, because it is well known that with experienced crews excellent pavements, in so far as surface conditions are concerned, may be produced."

The authors concluded that, "as far as can be judged by strength tests up to and including one year, as well as by a study of the number and distribution of cracks up to the present time, it appears that under the conditions obtaining on this job, either of the two proposed methods of curing concrete pavements covered by this study might be used in place of the wet-earth method.

"It must be remembered, however, that the final answer to such a question as this cannot be given until the various sections have been subjected to a sufficient number of seasonal changes to bring out any differences which may exist as to their comparative resistance to weathering. . . . It is recognized that the ultimate service value of the structure is dependent upon other factors besides strength, and that the effect of these factors upon the life of the pavement must be ascertained before giving unqualified endorsement to the special curing methods under consideration."

Sewer Tunneling With Portable Loader

A sewer 12 feet 3 inches diameter and 4,000 feet long is being built in Philadelphia in tunnel, being 30 to 40 feet below the ground level, Mason and Hanger of New York being the contractors. Construction is being carried on in both directions from a central point. An interesting feature of this work is that in both of the headings the contractor is using a portable conveyor for loading the excavated material into dump cars for removal from the tunnel. The excavated material is shoveled by hand onto the low foot end of the conveyor, which is a 21-foot



CONVEYOR FOR LOADING DIRT IN SEWER TUNNEL

Link-Belt conveyor of the belt type. This carries the dirt to a discharge height of 4 feet 8 inches above the track level, where it discharges it into side-dump cars, which are drawn by storage battery trucks to the elevator shaft, where the materials are raised to the surface. The conveyor was mounted by the contractors themselves on a small four-wheel truck arranged to run on the 30-inch gauge industrial track, which is readily pushed along the track as the work progresses. With the aid of these loaders and careful planning of the other details, the contractors have been able to tunnel at the rate of 60 to 70 feet per week or a little better than 10 feet per day, which is a considerable increase over the rate previously obtained.

Granite as a Bridge Pavement

Bridges on which shallow granite blocks have been laid during past few years

Under the above title a paper was read before the American Society for Municipal Improvements by Clarence D. Pollock of New York City, the larger part of which was a brief description of some of the more important bridges on which granite had been used as a paving material.

Heavy motor traffic has necessitated much heavier construction in bridges and greater rigidity of bridge floors than were formerly necessary, which has resulted in the common use of reinforced concrete slabs in floor constructions, with various kinds of paving material laid thereon. The traffic on bridges is more likely to move in definite lines than on street roadways and consequently there is greater tendency to wear ruts in the pavement; therefore the use of granite as a bridge pavement appears likely to increase in the future because of its great resistance to wear under this concentrated traffic.

The objection of weight has been advanced against granite as a pavement for bridges, but this objection has largely been eliminated recently by the use of shallow granite rock. While the additional weight of granite necessitates additional steel in the bridges, in important structures it has been fully warranted by the longer life of the pavement and the absence of traffic delays required by frequent repairs which are necessary with lighter floors and pavements.

The main features of the bridges referred to by Mr. Pollock are as follows:

Walnut Street bridge over the Schuylkill at Philadelphia. Laid in 1893 under George S. Webster, director of the Bureau of Surveys, and James W. Phillips. Still in service and in very good surface, although carrying very heavy trucking traffic. Blocks $2\frac{1}{2}$ to $3\frac{1}{2}$ inches wide, 5 to 7 inches long, and $6\frac{1}{2}$ to 7 inches deep, laid and bedded in Portland cement concrete and the joints filled with pebbles and pitch.

In New York City, approaches to the old Brooklyn bridge, to the Williamsburg bridge and the Manhattan bridge. Also several bridges over the Harlem river, blocks 4 inches deep generally being used. Successive use would appear to indicate satisfaction with the material.

Harvard bridge across the Charles river from Boston to Cambridge. Laid in 1924 under John A. Rablin, chief engineer of the Metropolitan District Commission, from designs of Lewis E. Moore. Blocks $3\frac{3}{4}$ to $4\frac{1}{4}$ inches wide, 6 to 10 inches long, and $3\frac{3}{8}$ to $3\frac{5}{8}$ inches deep. Close specification for depth was considered necessary to permit use of as thin a cushion course as possible. Six-inch creosoted tongue-and-groove plank flooring was bolted to steel stringers, and on this was spread hot asphalt top mixture as a cushion for the paving blocks, the joints being filled with hot asphalt cement. This is a cantilever bridge with considerable vibration and heavy traffic. Granite block pavement in perfect surface and condition after four years of service, with no broken blocks even at the ends of the cantilevers where there is impact in crossing the joints between cantilevers.

Hill to Hill bridge at Bethlehem, Pennsylvania. Built soon after the Harvard bridge, with Clarence W. Hudson as designer and chief engineer and Rodgers and Haggerty of New York as general contractor, and John Meehan & Son, Philadelphia, paving contractor. A series of concrete arches, steel spans and a long steel ramp, all paved with granite blocks from $3\frac{3}{4}$ to $4\frac{1}{4}$ inches wide, 7 to 11 inches long, and $3\frac{3}{4}$ to $4\frac{1}{4}$ inches deep, with cement grout filler.

Delaware River bridge between Philadelphia and Camden. Opened to traffic two years ago. Both approaches paved with granite block 4 to 5 inches wide, 8 to 11 inches long, and $3\frac{1}{2}$ to 4 inches deep.

with joints averaging $\frac{3}{8}$ -inch and not exceeding $\frac{1}{2}$ -inch at the top. Asphalt mastic filler flushed over the surface and squeezed into the joints. Ralph Modjeski, chief engineer, George S. Webster and L. A. Ball, as the Board of Engineers in charge.

"Peace Bridge" between Buffalo, New York, and Fort Erie, Ontario. Built in 1927. Entire structure paved with granite blocks from $3\frac{3}{4}$ to $4\frac{3}{4}$ inches wide, 7 to 11 inches long and 4 to $4\frac{1}{2}$ inches deep, with asphalt mastic joint filler. William R. Davis, Albany, N. Y., consulting engineer; R. B. Porter and Son, of Portland, Oregon, general contractor; John Meehan & Son, Philadelphia, paving contractor.

Washington bridge, Providence, R. I. Contract let recently to the Merritt-Chapman & Scott Corp., New York. From plans of Clarence W. Hudson, consulting engineer. Twelve concrete spans paved with granite blocks $3\frac{3}{4}$ to $4\frac{1}{4}$ inches wide, 7 to 11 inches long, and $3\frac{3}{4}$ to $4\frac{1}{4}$ inches deep, with Portland cement grout in the joints on the bridge itself, but asphalt mastic filler on the approaches to permit traffic to use the pavement as soon as laid.

Among other structures named are the viaducts which constitute a considerable part of the New Jersey State Highway's arterial highway connecting with the New Jersey end of the Holland tunnel.

In addition to the lighter weight of these shallow blocks, Mr. Pollock gives as additional advantages that they can be cut with more accurate sides and paved with closer joints; also their smaller heads can more easily be cut to a smooth surface, so that the surface of the pavement can be made sufficiently smooth to reduce impact to a minimum.

Landing Field at Ford Airport

The Ford Airport at Dearborn, Michigan, just outside of Detroit, was opened in April, 1925, and it is estimated that over 10,000 take-offs have been made by the Ford tri-motor ships, with an equal number of landings, and thousands more take-offs and landings have been made by visiting planes. Ford planes using this field have carried over one

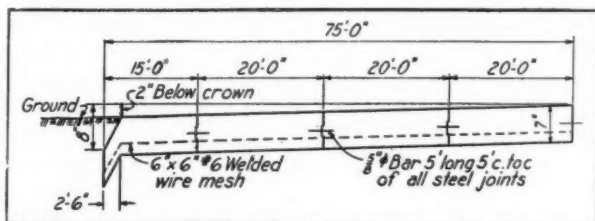
and a quarter million letters and 6,000,000 pounds of freight. The Stout Air Service carried 19,000 passengers in 1927 and about 27,000 during the first seven months of 1928.

The landing field has a good turf surface, well drained, but the difficulty of keeping this surface in good condition during thaws and sudden freezes in winter soon showed the officials of the company the need for a pavement of all-year, all-weather service. It was therefore decided to build a hard-surface runway, and 600 feet of such runway 75 feet wide was commenced late in 1927 and the entire runway, 2,653 feet long and 75 feet wide, was completed in the spring of 1928. This connects with the wide concrete driveway running along the hangars to the passenger station. Additional room for turning around was given by making the runway 125 feet wide for the last 100 feet; while approaching the passenger station and hangars the runway is widened to 150 feet. About two-thirds of this runway is concrete, but in the center are several hundred feet of heavy bituminous macadam, to test their relative desirability.

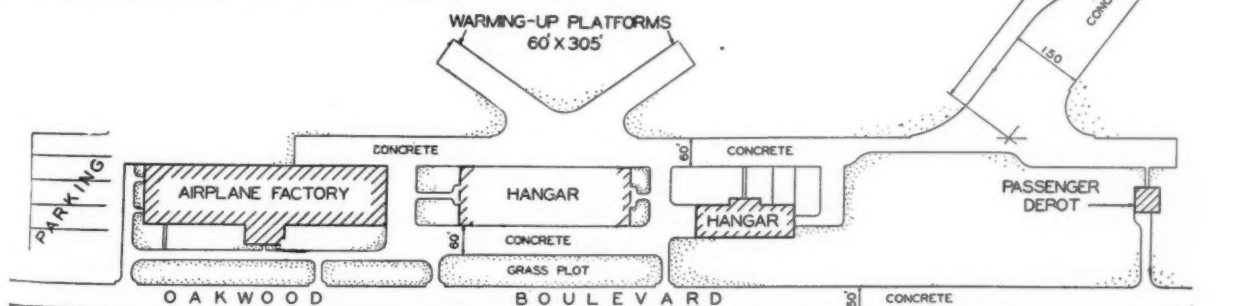
To provide for the 5-ton planes now operating, the concrete pavement was laid of one-course concrete 7 inches thick. The mix approximates 1 part portland cement, 2 parts sand and $3\frac{1}{4}$ parts gravel, the specifications providing that "concrete shall be proportioned to give the necessary workability without exceeding a water-cement ratio of $5\frac{1}{4}$ gallons of water to one sack of cement, which is the maximum permissible. Water or moisture contained in the aggregates must be included in computing the amount of water to be added to each batch."

The use of a finishing machine was required, and the concrete was then rolled and belted and tested with a straight-edge to insure a smooth surface with no irregularities greater than $\frac{1}{4}$ inch in 10 feet. A little extra care was taken to insure a smooth surface across all joints. Wire mesh reinforcement weighing 42 pounds per 100 square feet was placed 2 inches above the bottom of the slab.

Premoulded expansion joints $\frac{1}{2}$ inch thick were placed across the runway at 40-foot intervals. Parallel to the axis of the runway, the pavement is separated into slabs 20 feet wide by deformed metal joints. $\frac{5}{8}$ -inch steel dowels, 5 feet long, were placed on 5-foot centers, across the longitudinal joints to



STANDARD CROSS-SECTION OF CONCRETE RUNWAY



FORD AIRPLANE PLANT AND AIRPORT AT DEARBORN, MICH.
Layout of field, showing paved drives and runway.

hold the slabs in close contact. The outer edge of the slab was dropped 8 inches in the last 30 inches of width and the turf carried over to make a smooth connection. Along a part of the runway, 3-foot shoulders of slag or cinders, 7 inches thick after rolling, were placed next the slab to give a transition from concrete to turf.

This runway was constructed by the Otis Construction Company of Detroit.

With this hard-surface runway, the expense and inconvenience of using graders to keep the field smooth is greatly lessened. In all weather the heaviest planes can taxi smoothly down the concrete to the point of take-off without bump or jar, and the distance required for a perfect take-off is materially lessened. However, the length of runway was not reduced, the additional length giving a factor of safety that will be more valuable as the size and weight of loaded planes continue to increase. The runway has been marked with diagonal painted stripes to show the proper take-off distance from either end. If the pilot has not taken off by the time he reaches this point he slows down and taxis back for a new take-off.

According to W. B. Mayo, who directs the Ford Motor Company aviation activities, this runway has proven so satisfactory during the first few months of service that another is planned for immediate construction, to be built at right angles to the first.

Westchester County Highways

Westchester County, New York, has a traffic problem which is probably more complicated and acute than that of any other county in New York State if not in the entire country. The county has a population of 450,000 persons, and in addition to the traffic caused by these, since it lies immediately north

of New York City, all traffic between that city and New England must pass through the county, which extends from the unbridged Hudson river on the west to Long Island Sound and Connecticut on the east. The county converges at its southern end to a strip only seven miles wide where it joins New York City, and all of the traffic between that city and the north and northeast, and most of the northwest, passes over the roads in this narrow strip of land.

This traffic includes not only pleasure vehicles, but thousands of trucks carrying goods between New England and New York City pass through it. About 125,000 automobiles are registered in Westchester County. The Boston Post Road, on the east, alone carries about 40,000 vehicles in 12 hours, and the number carried by the Albany Post Road on the west side of the county is probably more than half as great.

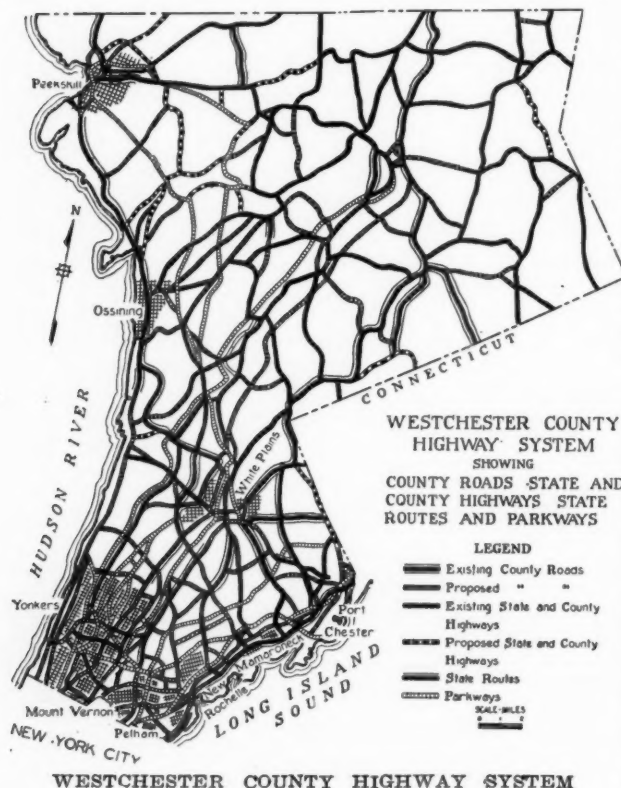
The present highway system in the county is a rather complicated combination of what are known as state and county highways, county roads, county parkways, and state roads. These handle the main trunk and arterial traffic, leaving local and residential transportation problems to the municipal streets and town highways.

State highways are constructed or improved at the sole expense of the state. There are three of these highways in the county—the Boston Post Road on the east, the Albany Post Road on the west, and the Saw Mill River Road through the center.

County highways are constructed and improved jointly at the expense of the state and the county. The Federal Government contributes to some of the costs of improving both state and county highways. County roads are constructed and improved jointly by the county and the municipality. County parkways are certain defined areas and roads owned and improved by the Westchester County Park Commission. State and county highways are built under the supervision of the County Department of Highways and the State Department of Public Works. There are in the county at present 376 miles of improved roads, 302 miles in the state system and 74 miles in the county system. Of the total mileage, about 215 miles are concrete or other hard surface construction.

Main road construction projects placed under contract by the state or the county in 1927 amounted to about two and a half million dollars, not including any work done in city or village streets or any of the large amount of newly opened privately owned developments.

The minimum width of pavement being constructed now is 20 feet, and within the last two years most of the improvements have been from 30 to 40 feet wide, while in 1928 60-foot widths are being constructed on the more heavily travelled roads. In addition to increasing the widths, the thickness of the concrete pavements also is being increased on major roads to 8 or 9 inches, and all are reinforced with steel bars placed in about 15-inch squares, giving about 85 pounds of steel per 100 square feet. Transverse expansion joints are placed at 50-foot intervals. Exposed edges are rounded to a $\frac{3}{4}$ -inch radius, and the joints are filled with asphalt. A dry concrete of 1-2-3½ mix is used, with careful attention paid to the ten days' curing under continuously wet hay or straw.



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Purifying Sewage for a Water Supply

About twenty-five years ago a proposition was submitted to the officials of Los Angeles for using the water supply over and over, by so purifying the city's sewage that it could be used as drinking water, while the solids removed would be valuable as fertilizer. Incidentally, the disposal grounds being very much lower than the city, the fall would be utilized to operate pumps for lifting the purified sewage back to the city. Needless to say, the project was never carried out.

But we describe in this issue a plant and procedure which reminds us of this joke of years ago—but this one is no joke. At the Grand Canyon the presence of thousands of tourists necessitates the use of 100,000 gallons of water a day for various purposes, but the cheapest way to get water there is to haul it about one hundred miles in tank cars at a cost of over \$300 a day. A very complete sewage treatment plant now purifies this water after it has been polluted by use, and 99 percent of it is rendered more acceptable for all purposes except human consumption than was the original water. Every precaution is taken to see that it is not used for drinking or the preparation of food. Only about 4½ percent of the 10 c.c. samples taken are positive for B. coli, which shows a remarkable degree of purification, but not safety for human consumption.

The cost of this treatment, including interest and depreciation, is about 58 cents per 1,000 gallons (of which the largest item is 22 cents for electric current); but would be about 30 cents if the plant operated at capacity. It seems probable that there are many towns or establishments in desert regions where the furnishing of water costs more than this, and where it would be economical to recover the sewage water for boilers, lawn sprinkling, street and sewer flushing, manufacturing of various kinds—purposes which use many times as much water as that used in the households.

Strength of Concrete Increased by Hauling It

One of the conclusions from core tests of concrete pavements several years old described on page 467 was the interesting one that not only did it not injure the concrete to haul it several miles ready mixed, but it actually appears to have benefitted it on the road examined. Cores taken three miles from the central mixing plant showed higher compressive strength than those a mile or less away.

No explanation is given or suggested in the report, but the investigators appear satisfied that the conclusion is justified by the results of tests of about one hundred cores uniformly disturbed along a four-mile stretch of road.

It suggests itself that this may be due to a consolidation of the concrete by the motion of the truck during the ten or fifteen minutes occupied in hauling it, whereby the surplus water is squeezed out as well as any air bubbles present, and the concrete is therefore more compact when deposited on the road than if discharged direct from the mixer; and better compacted at the bottom than is effected by tamping on the surface by hand. (Considering the

age of this pavement, it is probable that machine tamping was not employed).

This effect would apparently be produced, no matter what use is made of the concrete, and the conclusion should apply to concrete mixed at central plants and sold ready for use for foundations, cellar walls, buildings and other general purposes. Many such commercial mixing plants are being established in the large cities throughout the country; a Cincinnati company has recently completed one with a capacity of sixty cubic yards an hour. Such plants have facilities for much more accurate grading and turning out a better product than is probable with a small individual plant; and it would appear that, with no objectionable effects from hauling, there is much to recommend the use of such concrete where it is available. There is, of course, a limit of time and distance beyond which the concrete would begin to set and lose its desirability for use.

State Registration and the Status of Engineers

Six years ago the South Carolina State Legislature adopted a weak law providing for registration of professional engineers and land surveyors. At the 1928 session the law was amended by dropping provisions that made registration optional and requiring any engineer practicing or offering to practice engineering, with certain specified exceptions, to be registered. The State Board of Engineering Examiners takes the opportunity of the change in the law after six years' operation to give a brief resume of its experience in administering the law and some remarks and recommendations suggested by such experience. These are well worth reading by engineers everywhere, and we are quoting and abstracting some of the sentences and paragraphs which especially impressed us.

"The operation of the act has not brought about any epoch-making change either in the character of the engineering work being done in the state or in the status of the engineering profession."

"There are many men who in practice have developed the highest sort of skill, until it comes to be a sort of intuitive process for them to arrive at sound conclusions, yet who could be 'flunked' by an examination that a college student might pass with credit."

"It is difficult for an examination to reveal that subtle quality called 'judgment' without which no engineer is competent. For these reasons the board has not given examinations containing a mass of petty, theoretical questions about which the most accomplished engineer may be hazy. It has sought to make its questions direct, practical, and relating directly, in the main, to the engineering specialty in which the candidate professes proficiency. His answers are considered with reference to the record that he has made and to the tangible evidence which he submits of his experience, and the examination is prolonged until the Board is satisfied that the candidate is competent or incompetent, as the case may be. College training is regarded as one of the factors that helps to make an engineer, but the possession of a college diploma is not regarded as *prima facie* evidence that the candidate is an engineer.

"Another problem, which stated in an academic way seems to present insuperable difficulties, is that engineering is so varied in its demands for specialized knowledge and skill that registration of a man to practice engineering without definitely limiting him to his specialty will inevitably license him to do or undertake to do many things of which he is profoundly ignorant, thus defeating the whole purpose of registration. Practically the problem presents no such difficulty. . . . Registration seeks only to so draw the lines that within the registered group there will be a minimum of men lacking a sense of professional responsibility for the character of their work. It may be said that the highly trained man in some specialty would probably be the quickest to recognize his incapacity to tackle a job out of his specialty. The real danger lies with the half-trained man who has a smattering of knowledge in many specialties and real skill in none, and it is this type who, despite his ability to answer superficial questions over a wide range of examination, is most likely to fail of registration. The Board always has a sense of security when a candidate comes before it and demonstrates mastery of a specialty. Such a man usually understands the rigid technical procedure by which good engineering work is done, irrespective of the field in which it may be applied, and he is the least likely to fail to check every step that he takes.

"Another aspect of administration that presents a real difficulty is linked up with the great change that is taking place in the agencies through which engineering service is rendered. With the development of large engineering companies and corporations, and the growth of large state, municipal, public utility, railroad and other engineering organizations, the practice of engineering is becoming less and less a field for the individual practitioner. Whatever may be thought of this form of organization, it seems that it will be the agency through which practically all of the engineering work of the future will be done. Unlike such professional service, for example, as that of the physician, which is and will probably always be a service of an individual to an individual, engineering lends itself to group service. Except for a few specialized fields and a limited group of outstanding consultants, it seems that the engineer of the future is to be a salaried man. In the main it is to be expected that the large organizations will be manned by competent engineers, but it is not at all improbable that organizations will appear in this field which cannot or will not render the sort of service that the public has a right to expect. In principle, the organization should be required to demonstrate its qualifications just as the individual is; but since an organization cannot well be submitted to an examination, the Act provides that one or more officers or employees of such organization shall be registered. This is not entirely satisfactory, because the organization may be carrying on large and important operations under such conditions that the registered officers or employees have no direct supervision over the work. Large numbers of engineers working for these large organizations have as a matter of professional pride secured registration certificates, despite the fact that there is no legal requirement forcing them to do so. The Board hopes that as the idea of registration

gains more widespread acceptance, all qualified engineers will voluntarily follow this course. In this way an obvious defect in the law could be very largely overcome and the value of registration enhanced by voluntary rather than enforced measures."

"The object of registration was not primarily to improve the status of the engineering profession. As badly as this may be needed, it is nevertheless distinctly a matter for the profession to work out for itself. . . . It seems to be characteristic of the high-type engineer that he seeks his reward from society through constant improvement of his work rather than through exploitation and clamor. His immediate objective in registration is primarily to get the practice of engineering upon the right sort of plane so that the public may get the fullest benefit of his services. His own reward will take care of itself."

"As engineering knowledge and skill improve, so should the qualifications of engineers be progressively higher. But the greatest progress in this respect can and should come from engineers themselves. The quality of a professional group is measured by the standards that it sets for itself voluntarily rather than from a standard enforced by law. The law must be had, in order that the authority residing in the state may be effective in controlling such professional activity as would not be amenable to standards and codes of ethics arising within the profession, but no law of this kind can be wholly effective unless there is back of it a professional solidarity that demands a high standard of performance as a matter of principle."

Water Consumption For Bathing

An indication of the increasing use of plumbing, which will probably result in increasing per capita use of water, is afforded by an item in the 1928 report of the U. S. Secretary of Commerce; bathtub sales increased from 415,496 in 1919 to 1,101,000 in 1927. This is an increase of 165 per cent in eight years. During that period the increase in population is estimated to have been 13 per cent; giving a per capita increase in bathtubs of 135 per cent.

Association of Asphalt Paving Technologists

In January, 1924, during the American Road Builders' Association convention in Chicago, a rather informal association of asphalt paving technologists was formed, and this has been meeting annually since then. In 1926 a constitution and by-laws were adopted. The membership now approaches 100 and nearly all of those prominent in the industry as technologists are included, among them most of the consulting engineers specializing in asphalt paving and maintaining testing laboratories, state and municipal asphalt technologists dealing with the subject, many technical representatives of refineries producing asphalt, and a few technologists from the larger asphalt contracting organizations.

The members hope to be able to render better service to the industry and maintain a high standard of professional integrity and cooperation within their own rank and with those in the non-technical branches of the industry.

Members are elected by a Board of Directors, and

this board has established certain qualifications and it was the sense of the board meeting of March 19 last that these should come before the next annual meeting (to be held in New Orleans on December 4) as an amendment to the constitution.

The qualifications are as follows:

1. A university or college degree in engineering or chemistry plus a minimum of 3 years' experience in a responsible position connected with the production of materials used in asphalt paving or in the design and construction of asphalt pavements.

2. In lieu of a university or college degree: (a) At least ten years' practical experience in a responsible position concerned with either the production of materials for, or the building of asphalt pavements. (b) Each year in a university or technical school will be considered the equivalent of one-half year of practical experience in responsible charge.

3. Any person of special outstanding qualifications who has the unanimous approval of the Board of Directors.

4. Applicants must be actively engaged either in the production of materials used in asphalt paving construction or in the construction of asphalt pavements, at the time of application.

In addition to the above, it was the sense of the meeting that some qualification should be set up after a man becomes a member relative to his attendance and also his interest in furthering the ideals of the association. For instance, a man might be disqualified if he failed to attend more than two successive meetings, provided he did not have a good excuse, such as sickness, and providing he had not been active on committee work.

The president is LeRoy M. Law, of New Orleans; secretary-treasurer, Charles A. Mullen, of Montreal, Canada.

Safety on City Streets

Under the general heading of "Human Safety" the U. S. Department of Commerce, in its 1928 report, says, in reference to "Safety on the Street":

"The principal new activity of the National Conference on Street and Highway Safety during the past year has been the development of a model municipal traffic ordinance. In response to a general demand a committee of the conference was organized in July, 1927, and after extensive studies of existing ordinances and widespread distribution of a tentative draft of the model ordinance for public criticism and suggestions, its work was completed at a meeting July 5 to 7, 1928. The proposed ordinance, with explanatory text and suggested drafts of supplementary ordinances to create an official traffic commission, to create a division of traffic engineering, and to control roadway and sidewalk obstructions, was printed and distributed in August of this year.

"Hundreds of requests from both public officials and citizen groups for copies of the ordinance were on file before it was off the press, and since it became available there has been a heavy demand for additional copies. In a number of cities revision of the local ordinances was held up for some time awaiting the model ordinance, but is now in progress. A new traffic act, adopted at a special session of the New Jersey Legislature in July, is based on the draft of the model ordinance and also embodies important features of the uniform vehicle code proposed by the conference in 1926 for State enactment.

The States that have passed new laws based in whole or substantial part upon the uniform vehicle

code since it was drafted are Arkansas, Arizona, Idaho, North Carolina, North Dakota, New Jersey, Michigan, Minnesota, Pennsylvania, Virginia, and Washington. California, New Hampshire, and Oregon have amended their existing laws to bring them into closer harmony with the code. During the present year many inquiries have been received from, and copies of the code and other materials sent to, State officials and others interested in securing legislation in harmony with the code during 1929, when nearly all of the legislatures meet.

A committee of the American Engineering Council has nearly completed for the National Conference on Street and Highway Safety a manual of recommended practices in street-traffic signs, signals, and markings. This manual is based on an extended study of existing practices.

Developments since the Second National Conference on Street and Highway Safety, in March, 1926, when a comprehensive program of recommendations was formulated, have indicated the need for more intensive work along certain lines, and plans involving both new committee studies and active follow-up of previous recommendations are now being worked out with the national associations participating in the conference.

Winter Use of Quebec Highways

According to an announcement by the Minister of the Road Department of Quebec, it has been decided definitely to attempt to keep Quebec's trunk highways open during the winter months. Large motor snow plows will be used, also snow fences and other anti-drift methods.

It is reported that a group of Montreal and American capitalists contemplate the inauguration of an all-year-round automobile bus service between Montreal and New York City. It is planned to keep the main highway between Montreal and the border line open during the winter months, the cost of which will, it is estimated, be about \$200 per mile the first year and \$100 per mile in subsequent years.

Tenaflly Activated Sludge Plant*

The Tenaflly activated sludge plant, placed in operation Feb. 24, 1928, has a capacity of 750,000 g.p.d. but at present treats about 450,000 g.p.d. domestic sewage of varying strength from about 700 house connections.

The sewage passes a rack with 2" spaces, and a Tark screen 3' long, 4' diam. The screenings are delivered to a 15 cu. ft. container from which they are blown by air under 50 lb. per sq. in. pressure to 3 covered compost bins.

There is no odor outside the bins but as a safeguard the screenings are occasionally covered with sand.

The sewage is then lifted by two electrically-operated centrifugal pumps. The power required per mg. treated for pumping and aeration amounts to about 1.075 kw.h., treating 2,822 mg. in one week, besides 40 kw.h. for lighting.

The average amount of air used to aerate the screened sewage is about 1.10 cu. ft. per gal. The aeration tanks have a capacity of 128,000 cu. ft.

*By Kenneth Allen, sanitary engineer, Board of Estimate and Apportionment, New York City, in "Sewage Disposal Bulletin" of that board.

The aerated effluent is settled in two glass-covered Dorr clarifiers, 20'x20' in size and averaging 11' deep, whose combined capacity is 32,000 cu ft.

The clarified tank effluent is discharged by a dosing chamber to five sand filters 72'x185' in size and 36" deep on which there are about 30 dosings per day.

The sludge is delivered to two glass-covered sludge beds. Where exposed to the sun, drying takes about three days, but a week or more where in the shade. No odor is noticeable outside either the screening bins or sludge bed superstructures although some develop inside of each of these.

The clear filter effluent flows to a mixing chamber where some 6 lbs. of chlorine is added daily before discharge to the Hackensack river.

Concrete Street Paving Specifications

Principles and methods which should be embodied in them, and shortcoming of specification of the average municipality

In a paper before the 34th annual meeting of the American Society for Municipal Improvements, L. S. Trainor, manager, Highways and Municipal Bureau, Portland Cement Association, gave the results of a study of the concrete paving specifications of 125 cities, naming the features in which they were subject to criticism, and giving an excellent discussion of the principles and methods which should be embodied in proper specifications for concrete street paving.

The specifications studied by the Highways and Municipal Bureau of the Portland Cement Association were obtained from cities located in every state of the Union. Each district office of the association was requested to send copies of specifications representing the best practice in its territory, regardless of the size of the city, and at the same time to send a representative concrete paving specification from one city of over 100,000 population. These specifications should therefore represent something better than the average prevailing throughout the country.

The several features of the various specifications were then classified under 54 separate items divided under the 9 headings of: 1, grading; 2, materials; 3, forms; 4, concrete; 5, reinforcement; 6, joints; 7, finishing; 8, curing; 9, opening to traffic. The first two, grading and materials, were omitted in the study, since in general they depend to a large extent on local conditions.

Only about 50 per cent. of these specifications showed a trend toward modernization, while the remainder are out of date. While it is true that different conditions in different parts of the country might be reflected in the specifications, the fundamental principles of good concrete pavement construction are alike everywhere, these including the production operation, and the necessity of securing correct thickness of slab and properly finishing the surface. The wide diversity of the city engineers' work does not seem to be sufficient excuse for this

in the case of large cities, where the engineer generally has an assistant in charge of each phase of the work, which assistants should be specialists in their own lines. In small cities, where the engineering organization consists of one man with possibly an inexperienced assistant, he may be too overworked to familiarize himself with the best modern practice in all features of his work.

In summing up the study of these specifications, the following conclusions were reached:

CONCLUSIONS.

General Criticisms: 1. The specifications reviewed show not only a wide diversity of opinion but they also show a lack of knowledge concerning the best concrete paving practice.

2. City paving specifications are far behind state highway specifications.

3. A summary of the specifications for 125 cities shows that, on the basis of 100 per cent. for a perfect specification, those reviewed would rate only $33\frac{1}{3}$ per cent. as an average.

Specific Criticisms: 1. Methods of measuring aggregates to proportion the mixes are probably the most backward phase of all. The methods used are still the crude ones of the early days of concrete paving. The phrase so common to the specifications reviewed that "accurate methods of proportioning the aggregate must be used," means nothing without some interpretation.

2. The importance of control of the mixing water is recognized by 50 per cent. of the specifications, but no adequate means of regulating this important factor is provided in a majority of these cases.

3. The need for adequate mixing time is universally recognized by the specifications, but in only 50 per cent. of the cases is any requirement made that will aid in securing it.

4. Longitudinal joints are specified in 55 per cent. of the cases, but less than half of them show an understanding of the manner in which these joints should be constructed.

5. The value of transverse joints is conceded by most of the specifications, but a wide diversity of opinion exists as to the proper spacing and methods of designing them.

6. Two-thirds of the specifications require reinforcing steel, but in very few cases is the weight of this steel coordinated with the transverse joint spacing.

7. A trend toward finishing machines is shown by the fact that 58 specifications recognize that a machine might be used. In only 5 cases, however, is its use definitely required.

8. Follow-up finishing methods—those following the striking and tamping—disclose a wide variance and no complete and adequate description of how this work should be done.

9. The storage of aggregates on the subgrade is prohibited in only 25 per cent. of the cases. It must be presumed that, where it is not prohibited, it is permitted.

10. The value of "part-at-a-time" construction is definitely recognized in only one-third of the specifications.

11. The need for checking the depth of the subgrade is covered somehow in every specification, but

in only 52 of them is a sub-grade templet specified and in only 25 of them is its proper use required.

12. Curing specifications are generally adequate, but their proper enforcement is not. This is a matter of observation all over the country.

SUGGESTIONS.

1. The general adoption of a standard outline for concrete pavement specifications, which if universally used, would be of great benefit to contractors and engineers. The main headings, as well as the sub-headings, should stand out clearly.

2. The intent of the specifications should be made as clear as possible by a careful selection of words.

3. The intent should always be stated fully, leaving as little as possible to the interpretation of the individual engineer or contractor.

4. Where necessary, do not hesitate to state the limits to which the contractor can go in securing certain results, or to suggest alternative methods by which the result shall be obtained.

5. Methods or practices which have become more or less common by usage, but which it is proposed shall no longer be used, should be specifically ruled against in the specifications themselves.

6. The requirements of the specifications should always be ahead of the best construction practice. They should express the ideal results desired.

7. The fact that certain things have never been done is no reason for assuming that those things cannot be done. A little positive thinking will often clear the way to results which the negative line of thought suggests cannot be obtained.

8. It should be recognized that new methods or new requirements must always overcome the inertia generated from having done things in a certain other way. It is to be expected that at first the new way will seem awkward and slow and that results will be comparatively poor. Someone must apply the will power necessary to push the new activity to a successful conclusion. That someone should be the city engineer.

CONCRETE.

It is just as easy to obtain good concrete as poor concrete. Practically the same amount of labor is involved and the city certainly pays for good concrete whether it gets it or not. There are five essentials: 1, the proper kind of materials; 2, the accurate proportioning of these materials; 3, the proper amount of water in the mix; 4, sufficient mixing time; and 5, adequate curing.

The first is largely a local question, but satisfactory concrete aggregate should be clean, sound, durable and to be used economically should be well graded.

Accurate proportioning is vital to the production of uniform concrete, and can be obtained only by using some kind of device that will automatically regulate the proper amount of each material. It is not generally true that a batching plant is too expensive for small city work, since one or a few local contractors generally handle a large part or all the concrete work in the city, so that a batching plant once installed can be used for a variety of construction projects. Proper proportioning not only benefits the concrete but also is a distinct source of saving to the contractor because it conserves his materials.

Only 10 cities were found to require accurate

measuring devices. Eight allow weighing of aggregate, about half of these making this optional and the other half requiring it. Twenty-three permit wheelbarrow measurement of the aggregate, and 24 prohibit this, the remainder not mentioning it.

Thirteen cities permit storing aggregates on the subgrade, while only 31 definitely prohibit this practice, and the remainder do not mention it, and, as in the case of wheelbarrow measurement, it may be presumed that the practice is allowed, at least in the majority of cases.

Although the laboratory of the Portland Cement Association more than nine years ago brought out the fundamental truth that, everything else being equal, the strength of concrete depends entirely on the ratio existing between the amount of water and of cement, so long as the mixture is plastic and workable, and both that association and individual companies have spent thousands of dollars in bringing this discovery home to the engineering profession, in only three of the specifications was the straight water-cement ratio idea adopted, in thirty-two other cities the importance of the matter has been admitted to the extent that limits have been placed upon the maximum amount of water permitted to be used with one sack of cement; 72 per cent of the cities, however, leave this important question to be decided in the field by more or less inexperienced inspectors, aided in some cases by the slump test. However, 62 per cent of the specifications require a water-measuring tank on the mixer and 50 per cent of them specify a definite slump. It is admitted that the slump test is a valuable aid in judging consistency and hence the water content, but it is a make-shift and should be superseded by more accurate means.

MIXING TIME.

Every specification contains a clause stating the minimum permissible mixing time. The great majority specify one minute and only two specify less than that time, each being 45 seconds. Only half of the cities, however, require a timing device on the mixer, although this is standard equipment.

CURING.

Although the importance of curing is well known and curing is in some respects the most effective step in the manufacture of concrete, yet the practice seems to be going backward instead of forward, chiefly due to lack of executive ability in seeing that the contractor follows the specification. For some reason engineers seem to calmly ignore the means whereby they can greatly increase the strength and wearing ability of concrete pavements at no cost to the city, since the contractor has presumably included the cost of curing in his bid price.

Curing costs from 3 to 5 cents per square yard, and even if it was not already paid for it would be good business to pay that much additional to secure its benefits. Reliable tests show that concrete treated for ten days by moist curing increases its strength by 75 per cent over that obtained with no curing; keeping the concrete damp for three weeks increases the strength 115 per cent, for four months 145 per cent; while at the same time the concrete becomes more water tight and more resistant to surface wear.

THICKNESS OF PAVEMENTS.

Second only to the quality of the concrete is securing the required depth of slab. To obtain uniformly throughout the slab the required thickness, neither too great nor too little, requires real skill. Most of the methods found in the specifications, however, are mere make-shifts. It is of no moment that the subgrade is of proper depth a day or two ahead of placing the concrete, or even five minutes ahead of it, if it is not correct at the time the concrete is placed. And there is only one way to determine this, and that is to check the grade by some positive method after the mixer has passed over it and immediately before the concrete is placed.

A subgrade template so constructed that it will give correct information is the best tool. The specifications should require that grade be checked by this template after the mixer has passed by and immediately before the concrete is placed. If any high places show up in this checking they should be removed and the grade checked again, this operation being repeated until every part is at the correct elevation. A requirement of this kind, if enforced, will throw the burden of subgrade preparation on the contractor and will force him to prepare the grade carefully ahead of the mixer so as to minimize as much as possible the work behind the mixer. When it is considered that the ability of a road or street slab to resist loads varies as the square of its depth, the importance of proper depth may be fully appreciated.

The summary shows that 20 per cent of the specifications required that a template be used and that the grade be checked between the mixer and the concrete. 42 per cent required the template, but its use was not definitely stated. To all intents and purposes, therefore, only 20 per cent of the city engineers concerned take positive measures to control the important feature of correct depth of slab.

JOINTS.

Nearly all the specifications require some kind of transverse joints, but the type, size, and spacing of these joints vary so greatly as to suggest that, outside of the fact that the need for joints is realized, nothing else is agreed on. The average joint interval specified is 43 feet, but a spacing of from 25 to 35 feet is the most prevalent.

Longitudinal joints are being used more and more, 55 per cent of the specifications providing for this type of joint under certain conditions. However, only 23 per cent show a thorough appreciation of the manner in which such joints should be constructed, the design of joints in these cases being correct, whether it is done by using lock joints with tie bars or using thickened edges. Apparently 77 per cent of the engineers either do not see the value of longitudinal joints or, if they do, do not appreciate the effect of the joints and so design them as to eliminate the evil effect and retain the good. Although in some localities longitudinal joints can be dispensed with, in the large majority of cases they are of distinct benefit if properly designed.

Whatever the reason for using the longitudinal joints, the edges of the slab at these joints should be thickened, or a proper lock joint should be built so that the adjacent slabs will act as a unit in resist-

ing loads. Some specifications were found to provide for a lock joint of proper design when the whole width of the road was built at one time, but when the pavement is built in successive strips, only a plain butt joint is provided.

REINFORCING.

Sixty-six per cent of the specifications recognized that appearance of surface is a prime requisite in city work by requiring reinforcing, but too many indicate by the placing of transverse joints and the weight of reinforcing, that the engineer does not have the right conception of the relation of these two things to each other.

FINISHING.

The road slab must not only be strong enough to carry the loads placed on it, but must carry them with the least expenditure of tractive effort, and with the least discomfort to passengers. Motorists generally judge the efficiency of the construction work chiefly by the smoothness of the roadway. State highways are educating motorists to demand riding comfort on city streets.

In only five cities is a finishing machine required. It is true that just as good results can be obtained by hand methods as by machine methods, but a great deal more work and effort is required and some of this is so arduous that it is no doubt slighted in many cases.

To secure a smooth surface, it must be struck off, tamped, floated, straightedged and belted. The amount of floating and straightedging needed depends upon the accuracy with which the surface has been struck off and tamped. If a finishing machine and proper forms have been used, the work necessary to secure equal degrees of smoothness is less than if hand striking and tamping are resorted to. In either case, the ultimate result depends on the hand work done after the surface has been struck off and tamped.

The importance of this is oftentimes overlooked. It has been claimed that a finishing machine can not be used satisfactorily in city work but perhaps a little positive thinking will indicate that in many cases it can be used. This seems to be recognized in many cities for not only do 5 require it but 48 others make the use optional with the contractor and 5 others provide for it under certain conditions.

Great diversity of opinion and probably greater diversity of performance exists in the specifications covering the follow-up hand work. The value of a belt or similar tool is universally recognized and the straightedge is provided for in 72 per cent of the specifications. Twenty-six per cent specify a longitudinal float, while of course long-handled as well as short-handled floats are in use everywhere. The cause of rough pavements is not a lack of knowledge of proper tools to use but a lack of knowledge of how to use them or a lack of executive ability in seeing that they are properly used.

A method of finishing concrete pavements developed by one of the largest and most successful concrete road building highway departments in the country, which has resulted not only in a high degree of surface smoothness but also in greatly reducing the possibility of surface scale, is as follows:

1. The surface may be struck off and compacted either by hand or by machine. The usual precau-

tions should be taken to see that the forms do not settle and that the compacting is not overdone, as happens so many times with a tamping machine.

2. Belt the surface. Preceding the belting the surface may be floated with long handled wooden floats to smooth out rough places or to distribute mortar. This operation is sometimes necessary after tamping.

3. The surface should be straightedged for high and low places, using a 10-foot straightedge. Any irregularities should be removed by taking away or adding concrete and all disturbed places should be floated with a long handled wooden float.

4. The concrete should be allowed to stand for an appreciable length of time to allow excess water to come to the surface. The time necessary will vary according to atmospheric conditions. All excess water, laitance and inert matter should then be removed by scraping the surface lightly with either a wooden straightedge or a wooden float. These tools usually have a working face from six feet to ten feet long and are equipped with long handles. This operation not only removes the matter which usually scales off but by its planing action smooths out small irregularities which cannot be detected by straightedging.

5. Again test the surface for irregularities with the straightedge, remove them and float as in operation No. 3.

6. After the surface water has evaporated, the final belt should be applied. If applied at the right time and in the right manner the surface should have a coarse gritty texture.

The proceedings given above are merely in outline form. The successful application of this method depends upon the skill of the finishers, the judgment of the inspector and experience and thoroughness on the part of both.

PART-AT-A-TIME CONSTRUCTION.

The narrower widths of roads make it easier to secure good surface smoothness on them than on the wider city streets, which is recognized by approximately one-third of the specifications making it optional, and in some cases requiring, that the contractor construct the slab in successive strips. The wider the slab, the more difficult the work will be; striking and tamping tools must be longer and heavier and handles on floats and straightedges must be longer, and on wide streets it may be impossible to handle these latter tools in the ordinary manner; and more labor must be expended with less efficiency in result. Twenty feet seems to be about the limit for efficient results. Finishers can do well at that width by working from each side, but beyond that width tools become unwieldy and results slow and uncertain. Engineers recognize this difficulty and meet it satisfactorily by allowing or requiring part-at-a-time construction.

There are other benefits from this policy besides those accruing to the finishing process. This type of construction makes a longitudinal joint necessary and it also allows the street to be kept open to traffic if need be. In addition, it makes the use of a finishing machine easier. No single slab unit should be wider than 20 feet and part-at-a-time construction should always be required when streets are of this width or wider.

Recent Legal Decisions

COUNTY ENGINEER NOT AUTHORIZED TO INCREASE WIDTH OF ROAD UNDER CONSTRUCTION

The Kentucky Court of Appeals holds, *Pike County v. Waugh*, 1 S. W. (2d) 1066, that a contract for the construction of a highway 18 feet wide in accordance with plans and specifications and a map did not authorize the county engineer to order the width of the road increased to 24 feet, although the contract provided that the contractor should be paid for extra work ordered by the engineer; and the contractor was not entitled to recover therefor, the engineer's act in ordering the width changed being ultra vires and void. Admitting that the rule worked a great hardship upon the contractor in the case, the court applied the rule that, "persons dealing with municipalities must take notice of the limitation placed upon the agent's authority and deal with them at their peril." The court rejected the contention that, as the county made no objection to the progress of the road work and was receiving the benefit of the road, it was stopped to deny lack of authority on the part of the county road engineer, holding that the rule is applicable to individuals, but does not apply to municipalities.

JURISDICTION IN ACTION ON PAVING WARRANTS

The Circuit Court of Appeals, Fifth Circuit, holds, *City of Belton v. Omaha Trust Co.*, 17 Fed. (2d) 90, that a petition for recovery on paving warrants in the aggregate amount of \$2,177.83, matured warrants and interest, did not confer jurisdiction on the federal district court, although the petition sought to establish the validity of unmatured warrants which would have brought the amount over the \$3,000 jurisdictional amount. Jurisdiction was invoked on the ground of diversity of citizenship.

SOURCES OF COST OF PUBLIC IMPROVEMENT

The Circuit Court of Appeals, Fifth Circuit, says, *Brady v. City of Atlanta*, 17 Fed (2d) 764; "It is not illegal for a municipality to obtain from sources other than taxation or the proceeds of loans to it the whole or a part of the amount required to pay for a public improvement, and it may legally incur a debt for its outlay for such a purpose, though that outlay amounts to less than the entire cost of the improvement. Mayor, etc., of Washington v. Favor, 155 Ga. 680, 117 S. E. 653. It is not unusual for part of the funds required to pay the cost of a public improvement to be contributed, voluntarily or under lawful coercion, by owners of property to be specially benefited by such improvement."

REASONABLE TIME TO ACT ON BIDS WHERE NONE IS PROVIDED FOR.

Where there is no provision in the law, or in the prescribed form of bid, or in the advertisement or the specifications concerning the length of time bids should be subject to acceptance after they are opened, it is held, *Malahy v. Board of Education*, Ohio Appeals, 159 N. E. 324, that a Board of Education

which advertises for bids for the construction of a schoolhouse could hold the bidders to their bids only for a reasonable time, after the opening of the same, and that the lapse of 5¼ months after the opening of the bids before awarding the contract was more than a reasonable time. If the Board is enjoined from entering into a contract with one bidder, it cannot, after the lapse of such time, enter into a contract with another bidder, although such bidder is willing to be bound by its bid.

RENTAL OF ROAD ROLLER NOT WITHIN OHIO ROAD CONSTRUCTION BOND.

Rental of a road roller used in the construction of a county road does not fall within the term "machinery" or the "furnishing of machinery" as provided in Ohio Gen. Code § 8324, authorizing liens for the furnishing of machinery. *Ohio Savings & Trust Co. v. Schneider*, Ohio Appeals, 150 N. E. 338.

DISTINCTION BETWEEN DRAINING AND CONSTRUCTING DRAINS.

The Ohio Supreme Court holds, *City of Akron v. Lichtenwalter*, 159 N. E. 345, that the provisions of section 3812, General Code, make a distinction between "drains" and "constructing sewers, drains and watercourses." Under legislation for the paving of a city street and draining same, authority is not conferred to construct a sewer and assess any portion of the cost and expense thereof upon property abutting thereon.

OHIO ROAD CONSTRUCTION BONDS—AMOUNT—TIME FOR SUIT THEREON.

A contractor for a road construction improvement under the Ohio statute, Gen. Code, § 6906 et seq., must give bond in a sum equal to one-half the estimated cost of the work, which bond must in no case be less than one-half of the contract price. The Ohio statute limiting the time for an action on a bond for public work or other public improvement is applicable to a bond for highway construction. *Southern Surety Co. v. Standard Slag Co.*, Ohio Supreme Court, 159 N. E. 559.

IMPERFECT CONTRACT FOR ROAD REPAIRS RATIFIED BY TOWN VOTE.

The Massachusetts Supreme Judicial Court holds, *Twombly v. Selectmen of Billerica*, 159 N. E. 630, that the fact that a contract for road repairs failed to specify the amounts to be expended on each road, and in this respect did not conform exactly to the town vote authorizing the contract, did not render the contract invalid, since the contractor was strictly bound by the amounts of the appropriations in fact made for each road, although not specified in the contract. The contractor could collect for work on each road nothing in excess of the amount appropriated for that road by vote of the town, and must do substantially the work called for in the vote in order to recover. The contract, while imperfect, was not illegal, and was susceptible of ratification by vote of the town.

COAL IN PLACE HELD SUBJECT TO ASSESSMENT FOR ROAD IMPROVEMENT.

The Ohio Supreme Court holds, *Ross v. Short Creek Coal Co.*, 159 N. E. 583, that separately owned coal in place, acquired by deed which also granted "proper openings and the free and uninterrupted right of way into, upon and under said land at such points, in such manner as may be proper and necessary for the purpose of digging mining . . . and carrying away such coal" is real estate, subject to assessment for a road improvement under the provisions of section 3298-13, Ohio General Code.

STATUTE LIMITING LIABILITY OF CITY TO EXTENT OF SPECIAL ASSESSMENT HELD CONSTITUTIONAL.

The Illinois Supreme Court holds, *Monahan v. City of Wilmington*, 328 Ill. 242, 159 N. E. 199, that the Legislature has the right to specify the manner in which local improvements shall be made. Illinois Local Improvement Act. § 73, 83, 84, as to limitation of the liability of a city to the extent of special assessment, and authorizing certification of the cost of a public improvement, is held not unconstitutional because they prohibit a recovery upon an implied contract for extras. A contractor for the construction of the improvement is presumed to know the limitations which the statute places upon the contract on entering into it. The statute does not, it is held, impair the obligation of contract. It merely prescribes the manner in which a municipality may make improvements which are to be paid for by special assessment.

ORDINANCE PROVISION FOR FEES FOR EXAMINING AND CHECKING PLATS OF LAND HELD VALID.

The Ohio Supreme Court holds, *Prudential Co-op. Realty Co. v. City of Youngstown*, 118 Ohio St. 204, 160 N. E. 695, that a city ordinance which provides for payment of fees to the planning commission of the city for examining and checking plats of lands within the city or within three miles of its corporate limits is valid so far as the amount of fees is concerned, if the fees permitted to be charged by the provisions of the ordinance are reasonable and designed to cover the cost and expense of maintaining the planning commission. A payment unwillingly made under protest by an individual to an official in compliance with a fee or license statute or ordinance, in order to obtain official action in the matter covered by such statute or ordinance, is voluntarily made when no loss or damage would accrue to such individual other than the damage naturally resulting from withholding or delaying such official action.

LIABILITY FOR HOLES LEFT IN ROADWAY DURING SUSPENSION OF CONSTRUCTION

The Nebraska Supreme Court holds, *Pratt v. Western Bridge Construction Co.*, 218 N. W. 397, that where a contractor employed by a county to construct culverts along the line of a newly built highway which has been completed as to grading with a roadbed 24 feet wide, open to public travel, lays a culvert pipe under a fill in the road and covers it so that the roadbed at this point is narrowed to 12 feet leaving holes on each side of the traveled way, and abandons the work in the fall, to be resumed in the spring, without filling the holes, into one of which an automobile is driven in the night-

time, resulting in the death of an occupant, the questions of negligence and contributory negligence were for the jury. Such work is not repair work imposed by law upon the county so that action is not barred by the statute requiring suit within 30 days of accident caused by want or insufficiency or repairs of a highway. It would not be a defense that the person injured was driving an unregistered automobile.

EMPLOYERS' LIABILITY LAW—NONRESIDENT CONTRACTOR AND RESIDENT EMPLOYEE

The Nebraska Supreme Court holds, *Watts v. Long*, 218 N. W. 410, that the Nebraska Employers' Liability Law is not applicable to a nonresident employer and a resident employee where the contract of employment was made in Nebraska for services to be performed in another state and the employer was not then engaged in any trade or avocation in Nebraska. An employer, resident and having his principal place of business in Kansas, was engaged in paving highways in that state and in Nebraska under contracts with municipalities. Upon completion of his last contract in Nebraska, he entered into a contract in that state with an employee, engaged upon that contract, to go to Kansas and work upon paving contracts there, returning to Nebraska if the employer secured other contracts in Nebraska in the future. It is held that (1) at the date of the contract the employer was not conducting any industry in Nebraska; (2) the work of the employee was not an incident to any such industry; and (3) the Act did not apply to such contract. Where such employer carried liability insurance in both states under one policy, the Employers' Liability Act of the state in which the contracts were being performed governed the relations and rights of the parties as to compensation to an employee for injuries received while performing work under or incidental to such contracts.

MAINTENANCE CLAUSE IN PAVING CONTRACT

Under his contract a paving contractor was not responsible for defects resulting from wear and tear, but was responsible for other defects occurring within five years of the paving. Evidence that patches were made about a year after the completion of the five years and were rendered necessary by the regular wear and tear of the pavement did not show that a breach of the contractor's obligations had occurred six months earlier and that the patches were made necessary thereby, regardless of the claim that the contractor's failure to notify the city to inspect within 60 days prior to the expiration of the five-year period kept the maintenance clause of his contract in effect after the five-year period. *Central Trust Co. v. City of Des Moines*, Iowa Supreme Court, 218 N. W. 580.

COUNTY NOT LIABLE FOR UNAUTHORIZED ROAD REPAIRS ORDERED BY INDIVIDUAL COMMISSIONER

The North Dakota Supreme Court holds, *Rolette State Bank v. Rolette County*, 218 N. W. 637, that a board of county commissioners is an entity, and, in order to bind a county, there must be formal action on the part of the commissioners as a board. An individual member of the board is not empowered to act alone; and a county is bound by his act only where the law expressly authorizes him so to act, or where he has been duly authorized by the

board, and then only in a matter wherein the board is empowered to confer such authority. The North Dakota statute, Compiled Laws, Supp. 1925, §1946 b, does not authorize a member of such a board to contract on behalf of the county for the construction or repair of roads. It merely empowers the board to appoint one or more of its members as overseers in laying out and constructing or repairing roads, bridges, and other property, and to compensate them therefor. Where a county commissioner contracted with contractors to do some work on the roads on his district, without the knowledge of the board, the county was not liable therefor. As the services were of such a nature that the county had no choice but to accept them there was no acceptance and no liability.

The mere fact that services beneficial to the county were rendered is not sufficient to impose a quasi contractual obligation upon the county to compensate the person who performed such services. Such obligation arises only when the services have been performed in such circumstances, and where there has been such conduct on the part of those whose actions may bind the county, as to impose upon it the legal obligation to compensate therefor.

DAMAGE FROM NEGLIGENT OPERATION OF SEWAGE DISPOSAL PLANT—STATUTE OF LIMITATIONS

The Oklahoma Supreme Court holds, *Town of Davis v. Thomason*, 264 Pac. 877, that where action is brought against a municipal corporation for damages on account of the negligent operation of its sewage disposal plant and such acts of negligence are shown to have occurred within two years prior to the institution of said action, a plea of the statute of limitations will not bar a recovery thereon although it is shown that said disposal plant was installed more than two years prior to the institution of the action.

IMPAIRMENT OF ACCESS TO BUILDING BY BRIDGE CONSTRUCTION

The Kansas Supreme Court holds, *Nelson v. City of Ottawa*, 264 Pac. 1049, that an action against a city for damages for destruction of a property owner's ingress and egress cannot be maintained without first filing a written statement giving the time and place of the happening of the accident or injury received and the circumstances relating thereto as required by Kansas Rev. St. 12-105. Outside of the question of notice, the court said that it was extremely doubtful whether the impairment of a perfect access to a building by the handrail of a bridge was a substantial ground of damages.

COUNTY NOT COMPELLED TO CLOSE ENTIRELY ROAD UNDER REPAIR

The Nebraska Supreme Court holds, *Boomer v. Lancaster County*, 218 N. W. 751, that a county cannot be held to be an insurer of those who have occasion to use a county highway in process of repair. It is required to use such care as under the circumstances is reasonable and ordinary in its inspection of the highway and in the execution of such repairs as it finds necessary or undertakes to make. It is required to use reasonable and ordinary care to maintain the highways reasonably safe for the traveler using them while in the exercise of reason-

able and ordinary care. In an action for injuries to an automobilist at a culvert undergoing repair when the car struck a pile of dirt, it appeared that the road was partly barricaded by a plank and a sign of closed road and a red light marked the dirt pile. It was held that the county was not liable in having the roadway open for general travel or for its condition at the culvert; since it would have been a hardship to those living along the line to barricade the road against all travel, and it was sufficient if such signs and warning were given, and such passageways past the improvements were provided, that one driving with due and ordinary care might go through without mishap.

DISCRETION TO REJECT ALL BIDS FOR FRANCHISE

The Kentucky Court of Appeals holds, *Groover v. City of Irvine*, 300 S. W. 904, that in granting franchises for the public benefit, a city council acts in a legislative capacity. In the exercise of this power a discretion is vested, which cannot be taken away by the courts. Inasmuch, however, as the members of the city council act as trustees for the public to the end that the latter may obtain such conveniences as telephones, electric lights, and the like, they may not, after the sale of a franchise, reject all bids and thereby escape the obligation to award the franchise to the highest and best bidder. However, when the exercise of the power and discretion to reject bids is attacked in the courts, the presumption will be indulged that the council has not abused its discretion, but has acted with reason and in good faith for the benefit of the public.

All who take the obligation of a town to pay money must ascertain for themselves whether the obligation was issued by competent authority, and a purchaser of a town order or note takes it at his peril of the fact. If not issued by competent authority, the town is not liable. Those who accept the obligations of a town are charged with knowledge of the contents of the town's records purporting to give authority to execute such obligations, as well as the provisions of the statutes. Under the Wisconsin Statute, §348-28, a note given by a town to a bank, which was executed by and the loan negotiated by municipal officers who were at the time officers and stockholders of the bank was absolutely void. *Town of Swiss v. United States Nat. Bank*, Wisconsin Supreme Court, 213 N. W., 842.

COMPLIANCE WITH ORDINANCE REQUIRING PREPARATION OF SEWER PLANS AND SPECIFICATIONS

The St. Louis Court of Appeals holds, *City of Ferguson v. Steffen*, 300 S. W. 1039, that an ordinance requiring the mayor to prepare and submit plans and specifications for the construction of sewers and a septic tank were substantially complied with although he did not formally refile the plans and specifications which he had previously prepared and filed, where his estimate of the cost of the work, which he prepared and filed on the day succeeding the passage of the ordinance, was based on said plans and specifications, this necessarily amounting to an adoption by him of said plans and specifications, and the board of aldermen then passed another ordinance adopting and approving said plans and specifications and estimate of the cost.

NEWS OF THE SOCIETIES

Dec. 3-7—ASPHALT ASSOCIATION. Seventh annual conference at New Orleans, La. J. E. Pennybacker, Mgr., 441 Lexington Ave., New York City.

Dec. 10-12—NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual conference at New York City. Elmer Thompson, Sec'y., 12 E. 53rd St., N. Y.

Dec. 13-14—HIGHWAY RESEARCH BOARD. Annual meeting at Washington, D. C. R. W. Crum, director, Washington, D. C.

Jan. 14-18—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and Road Show at Cleveland, O. C. M. Upham, Washington, D. C.

Jan. 16-18—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual Meeting at New York. Geo. T. Seabury, Sec'y., 33 W. 39th St., N. Y.

Feb. 12-14—AMERICAN CONCRETE INSTITUTE. Annual Convention at Detroit, Mich. Harvey Whipple, Sec'y., 2970 W. Grand Blvd., Detroit, Mich.

Feb. 13-15—ASSOCIATION OF STATE HIGHWAY OFFICIALS OF THE NORTH ATLANTIC STATES. Fifth Annual Convention. A. Lee Grover, Sec'y., Trenton, N. J.

Feb. 18-22—ASSOCIATED GENERAL CONTRACTORS OF AMERICA, INC. Annual Meeting at Chicago, Ill. D. H. Sawyer, Sec'y., Washington, D. C.

Feb. 26-March 1—SOUTHWEST ROAD SHOW AND SCHOOL. Fourth Session at Wichita, Kans. F. G. Wieland, manager.

May 13-15—NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual Convention. Stevens Hotel, Chicago. Secretary, Elmer Thompson.

June 24-28—AMERICAN WATER WORKS ASS'N. Annual Convention at Toronto, Ont. Beekman C. Little, Sec'y., 170 Broadway, N. Y.

THE A. S. M. I. CONVENTION

The 34th annual convention of the American Society for Municipal Improvements was held in Detroit, Michigan, October 22nd to 26th. Meetings of the executive committee and of the several specification committees were held in the afternoon of the 22nd. The members and guests met at an informal dinner at 6:30 and the convention was formally opened that evening with addresses of welcome, president's address, reports of the executive committee, treasurer, finance committee and others.

Technical sessions for the reading and discussion of papers began on Tuesday morning and continued during that afternoon, Wednesday morning and evening, Thursday morning and afternoon, and Friday morning. On Wednesday the election of officers was held with the following result: President, John Klorer of New Orleans; first vice-president, P. L. Brockway of Wichita, Kansas; second vice-president, John W. Reid, Detroit, Michigan; third vice-president, J. H. Neeson, of Philadelphia, Pa. S. Cameron Corson was continued as treasurer and C. W. S. Sammelman as secretary.

A number of amendments to the constitution were adopted by the convention and ordered to letter ballot by the Society. These were amendments proposed by the Constitutional Organization Committee making a minor change in the procedure of electing members; giving associate members "all the rights and privileges of

active membership excepting those of holding elective office"; providing for eliminating from the executive committee any past president who has been absent from three consecutive annual conventions; providing that between conventions all business of the society shall be transacted by a committee composed of the president, the first vice-president, the treasurer and the two immediate past presidents; and providing for the formation of local sections of the society.

One unusual feature of the convention was that all sessions were begun promptly on time or within not more than 5 minutes after the hour set. As a result of this and of careful planning of the program, all papers and discussions were kept up to schedule except for one session, the schedule being caught up with at the session immediately following. A number of the papers were discussed at some length, that of Charles M. Reppert entitled "Modern Paving Base Construction for Present Day Pavements" probably receiving the most extensive discussion of any.

Quite a little interest was displayed in the matter of airport sites, which was the subject of a paper by Perry A. Fellows, city engineer of Detroit. T. Chalkley Hatton expressed the belief that in a few years fields with runways not more than 250 feet long will be ample, the Navy already having planes which can land within that distance.

In two papers on Wednesday morning, D. W. Townsend, chief engineer of the Milwaukee Sewerage Commission described the digester plant used for digesting fine screenings at the sewage plant of that city, which was preceded by a paper by Dr. Rudolfs describing the biological, chemical and physical principles developed by an investigation made in working out the plans for such a digester plant. An abstract of these papers appears elsewhere in this issue.

George B. Gascoigne gave a brief history of the developments of sewage aeration and a comparison of the diffused air, surface agitation and combined systems for producing activated sludge or sewage aeration. In discussing this, Samuel A. Greeley stated that plants using both diffused air and surface agitation had been operated at Decatur, and that the cost by the two methods was very nearly the same, being about \$200 cheaper by a Simplex experimental plant than by a diffused air service plant.

On Thursday morning L. S. Trainor of the Portland Cement Association read a very interesting paper based on information obtained by a questionnaire replied to by 125 cities. He had reached the conclusion that too small a percentage of the cities were securing reasonably good adherence to approved specifications for con-

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crete base construction and that much more attention should be given to the details of such construction. Replying to a question on the use of calcium chloride, he stated that this acts differently with different brands of cement. Following this discussion E. A. Fisher proposed a resolution, which was adopted, reaffirming the specifications of the society which provide that guarantees on pavements should not run for a period exceeding five years.

As stated above, Mr. Reppert's paper, which followed Mr. Trainor's, received considerable discussion. He described recent developments by the Pittsburgh Department of Public Works in the construction of concrete pavement bases. Under the present plan, all aggregates are tested at the dock and each truck load is given an acceptance slip. At first about one-third of the aggregate was rejected, but now that the producers understand the city's policy, very little is rejected. Before this plan was adopted most of the aggregate received was dirty and was quite variable in size. Though the quality of the aggregate has greatly improved during the past three or four years, there has been no material increase in cost. Most of the base continues to be made 6-inches thick; if on certain soils the base has failed, this has been remedied by drainage of the subgrade rather than by increasing the thickness; although in some cases 8-inch and even 10-inch bases have been used for very heavy traffic. In the past, drainage of the soil under the pavements was secured by broken stone under the curbs; the present practice is to use layers of broken stone or gravel 4 inches or more thick, with or without French drains, under the pavement; the stone being placed in layers and each layer thoroughly rolled. The concrete must be mixed a minimum of 1½ minutes, and the slump does not exceed two or three inches, about 5½ gallons of water to a bag of cement being the amount required, which makes a stiffer cement than was formerly the practice. No chute mixers are allowed. A core drilling machine has been ordered and in the future drilled cores will be used for testing the strength and composition of the base. When used as a foundation for block pavement, the base is cured five days before laying the block. When used for bituminous material, it is cured about a week and then allowed to stand for another week before laying the surface material. No concrete is placed when the temperature is below 45° if it can be avoided. An investigation of the pavement bases in 1922 found that 75% of them were gone or nearly gone; but the poorest concrete foundation laid today is better than the best that they found in 1921. Discussing the paper, Mr. Pollock believed that the 1:2:3 mixture used in Pittsburgh is too rich, in that it produces infrequent but wide cracks, and that a 1:3:6 mixture was preferable. W. W. Horner of St. Louis also believed in the leaner mixture, but otherwise the practice in his city was very

similar to that in Pittsburgh. His greatest difficulty was with trenches, the refilling of which kept settling for several years and in some cases the city required refilling with granular material. Mr. Reppert stated that in Pittsburgh the backfilling under the high grade pavements is made with sand, gravel or slag. Several other members expressed the opinion that a 1:3:6 mix, if actually obtained, was good enough for practically any city pavements.

On Friday morning reports were received from the several specification committees but practically none of these had anything of importance to offer in the way of suggested changes, most of them recommending that the specifications as already adopted be continued in use.

Invitations had been received from a number of cities to hold the 1929 convention with them, but the selection was finally made of Philadelphia, the date to be decided upon later.

THE AMERICAN PUBLIC HEALTH ASSOCIATION

By Dr. James A. Tobey, Dr. P. H.

The election of an engineer as its president was perhaps the most significant action of the American Public Health Association, the fifty-seventh annual convention of which was held in Chicago from October 15th to 19th, 1928. In electing George W. Fuller of New York as president, the American Public Health Association has honored a practicing engineer with this office for the first time since 1913 when Rudolph Hering served in a similar capacity. In 1924 Henry F. Vaughan, Dr. P. H., Health Commissioner of Detroit, who had been trained as a sanitary engineer, was president of the Association.

Another engineer, H. A. Whittaker of the state Board of Health of Minnesota, was one of the ten members elected to the Governing Council of the American Public Health Association. Officers of the Public Health Engineering Section of the Association for next year were elected as follows: chairman, Stephen DeM. Gage of Providence, R. I.; vice-chairman, John F. Skinner of Rochester, N. Y.; and secretary, George W. Putnam of Chicago, Ill.

The fifty-seventh meeting of the Association had a registration of more than 2,500, which exceeded by over 1,000 the previous high record. That this was the biggest convention of the Association was due in part to the fact that several other societies, including the American Child Health Association, the American Social Hygiene Association, and the Illinois Association of Health Officers and Public Health Nurses held meetings in conjunction with that of the American Public Health Association. Immediately prior to it, the Conference of State Sanitary Engineers and the International Association of Dairy and Milk Inspectors also held meetings.

Symposiums on school room ventilation, shellfish sanitation, the sterilization of milk containers and equipment, the financing of water supply and

sewerage projects, the disposal of phenol wastes, and research in sewage and industrial waste disposal were features of the meetings at the Public Health Engineering Section under the chairmanship of Arthur E. Gorman of Chicago. In addition, papers were presented on air pollution, milk supplies, and screening campaigns.

The most important resolution from the standpoint of the engineering profession which was adopted by the Association as a whole was that urging Congress to pass the Parker bill for federal health coordination over the veto of the President. This measure, which was adopted by the 70th Congress at its first session, provides among other matters for a commissioned status for the sanitary engineers and other non-medical scientific personnel of the United States Public Health Service. President Coolidge vetoed this bill on May 18, 1928, giving as one reason for this surprising action the fact that in his opinion the granting of such commissions tended to "militarize" the Public Health Service.

Among other resolutions adopted at this convention were those urging Congress to continue federal aid for necessary health work in counties in the flooded and hurricane areas; urging Congress to pass a bill recognizing the services of the army and civilian heroes who participated in the famous yellow fever experiment in Cuba under Walter Reed; urging Congress to grant second class mailing privileges to county and municipal health bulletins; and a resolution recommending the more efficient general reporting of tuberculosis.

In addition to George W. Fuller as president, other officers of the American Public Health Association were elected as follows: first vice-president, Dr. A. J. Chesley of Minnesota; second vice-president, Dr. Norman MacL. Harris of Ottawa, Canada; third vice-president, Dr. Louis J. Schmidt of Chicago; and treasurer, Professor E. O. Jordan of Chicago. Dr. Herman N. Bundesen of Chicago was the retiring president, and Mr. Fuller had been serving as first vice-president and also as a member of the Executive Board of the Association.

AMERICAN ROAD BUILDERS' ASSOCIATION

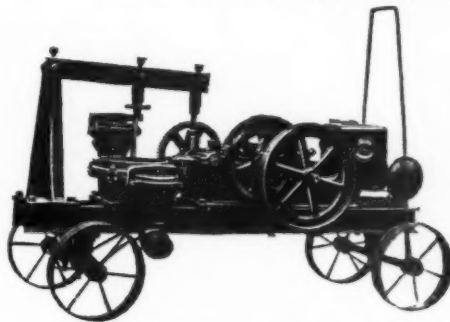
The nominating committee of the American Road Builders' Association has nominated the following officers for 1929-1930, and directors for three years:

For president: Frederick A. Reimer, consulting engineer, East Orange, N. J.; for vice-presidents: W. A. Van Duzer, assistant chief engineer, Pennsylvania Department of Highways, Harrisburg, Pa.; D. B. Dimick, president, American Casting Co., Birmingham, Ala.; S. F. Beatty, president, The Austin-Western Road Machinery Co., Chicago, Ill.; Samuel Hill, honorary life president, Washington State Good Roads Association, Seattle, Wash.; for treasurer: James H. MacDonald, consulting road and paving engineer, New Haven, Conn.

For directors, term ending 1932: J. H. Cranford, president, Cranford Paving

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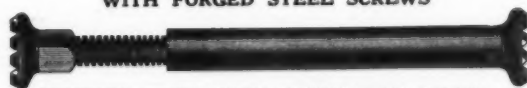
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ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES

The Fifth Annual Convention of the Association of Highway Officials of the North Atlantic States will be held at the Hotel Ambassador, Atlantic City, N. J., February 13-15. A Lee Grover, State Highway Department, Trenton, N. J., is secretary.

HIGHWAY RESEARCH BOARD

The Eighth Annual Meeting of the Highway Research Board will be held on December 13 and 14, 1928, at the National Academy of Sciences and National Research Council Building, B and 21st Streets, Washington, D. C. This will be an open meeting and everyone interested in the development of the construction and use of highways is invited to attend.

COMMITTEE REPORTS FOR 1928 MEETING

Structural Design. A. T. Goldbeck, Chairman. It will be the aim of the committee to present its report in such a manner that the data will be immediately available to the practicing engineer. It is hoped to present practical methods based upon sound research for taking care of unusual drainage and other subgrade conditions, as well as methods for design of both rigid and non-rigid pavements, covering cross section, reinforcing, joints, dowel spacing, edge strengthening, and design of secondary roads.

Reports on new developments in finishing bituminous surfaces, the Bouyoucos hydrometer in making mechanical analysis of soils, settlement in peat marshes, and factors to be considered in the correlation of soil and pavement conditions will be made. Individual portions of the report will be presented by H. M. Westergaard, V. R. Burton and Samuel Eckels.

Character and Use of Road Materials. H. S. Mattimore, Chairman. Two principal topics will be discussed. A report of the extensive research work upon which the Pennsylvania design for guard rail is based will be made by Mr. Mattimore and a discussion of the properties of bituminous materials for surface treatments is in preparation by Messrs. Emmons, Lang and J. E. Myers.

Highway Traffic Analysis. G. E. Hamlin, Chairman. The committee will discuss the relation of traffic to accidents under these headings: Accidents on State Highways; Safety on State Highways as Compared with City Streets and County or Township Roads; Safety of

Highly Improved Roads as Compared With Lightly Improved or Unimproved Roads; Safety of Heavily Traveled Roads as Compared With Lightly Traveled Roads; Effect of Physical Conditions of Road on Recurrence of Accidents; Effect of Increasing Volume of Traffic on Recurrence of Accidents.

Last year's report will be reviewed and data with respect to capacity of two, three and four-lane roadways, time losses, and effect of various physical conditions upon carrying capacity etc., will be brought up to date. Dean Johnson will present an illustrated report on the Maryland Aerial Traffic Survey, between Washington and Baltimore.

Highway Finance. H. J. Kirk, Chairman. A review of the methods used in the various states in promoting the financing of state highway systems will be reported. There will also be a discussion of sound economic principles in the financing of road improvements.

Causes and Prevention of Highway Accidents. A. N. Johnson, Chairman. Owing to the untimely death of Chairman Fletcher, the work of this committee has been greatly retarded. A reorganization has been effected under Dean Johnson and plans for the future will be presented. The committee expects to report its recommendations concerning the Model Municipal Traffic Ordinance and Model Motor Vehicle Law of the National Conference on Street and Highway Safety.

Economic Theory Of Highway Improvement. T. R. Agg, Chairman. Professor E. H. Lockwood will discuss the Yale experiments on air resistance of automobiles.

Maintenance. G. C. Dillman, Chairman. The report will discuss briefly and bring up to date, the topics covered during the past few years, making definite recommendations wherever possible. Among the list of subjects are: Crack Fillers for Concrete Pavements; Dust Prevention and Surface Treatment of Gravel; Roads Including Sizes of Mulch Gravel; Bituminous Wearing Surfaces for Gravel Roads; Rhythmic Corrugations in Gravel Roads; Maintenance Machinery for Gravel Roads; Earth Roads Oiling; Bituminous Treatment of Earth, Sand-clay and Top-soil Roads; Snow Removal—Equipment and Drift Prevention; Guide, Caution and Danger Signs; Maintenance Accounting; Maintenance Costs as Affected by the Life of the Road; Maintenance Costs as Affected by Type of Pavement and Amount of Traffic; Coverings for Poorly Constructed and Disintegrating Concrete Pavements; Maintenance of Concrete Pavements; Annual Reduction in Thickness of Gravel Roads Under Different Traffic and Effect of Dust Palliatives; Berm Maintenance; Cause and Cure of Frost Boils; Bridge Maintenance, Including Painting and Reflooring.

PERSONALS

Colonel Ernest McCullough has resigned as editor and Edward S. Hanson as managing editor, of Building

Age and National Builder. They are associated as merchandising counsel specializing in publicity in the engineering, architectural and construction fields, with offices in Salmon Tower, New York City.

W. D. Gerber has been appointed chief engineer of the Illinois State Water Survey.

W. A. McGraw has been appointed sanitary assistant in the Division of Sanitary Engineering, Missouri State Board of Health. His work will include supervision over tourist camp, summer resort and highway comfort station sanitation.

Francis Feher has left the Engineering Department of the City of Cleveland to become Designing Engineer for the Cleveland Union Terminals Co.

S. C. Bloom and Charles F. Kamrath have formed the firm of Bloom and Kamrath, with offices in the Monadnock Block, Chicago, and will conduct a consulting and architectural engineering business.

E. W. Gotwals, formerly of the Missouri Highway Commission, has been appointed resident engineer on highway construction in Jackson County, Mo.

Frederick K. Copeland, president of the Sullivan Machinery Company since 1892, died at Claremont, N. H., Nov. 10th, following an operation for appendicitis. He graduated from M. I. T. in 1876, spent several years in mining engineering, and in 1884 helped organize the Diamond Prospecting Co. which, 1892, merged with the Sullivan Machinery Co. He was a member of the Am. Inst. of Mining and Metallurgical Engineers, Am. Soc. of Mechanical Engineers and other engineering societies and clubs. He had served as a trustee of M. I. T.

TRADE PUBLICATIONS

Selecting Culverts and Drains on the Basis of Cost Per Year.—Armco Culvert Mfrs. Ass'n., 24 pp., ill. Bulletin H-34. This pamphlet is said to be a review of the factors which, when collectively considered, permit true cost comparisons between structures serving the same purpose.

Snow Removal Equipment. The Good Roads Machinery Co., Kennett Square, Pa., has just brought out their 1928-29 snow removal catalog. This, in its 56 pages, illustrates and describes fully the complete line of snow plows put out by this company.

General Electric Co., Schenectady, N. Y. A 24-page illustrated catalog describing G-E Novalux traffic signals. There is also a discussion of systems of traffic flow and brief specifications for Novalux.

General Electric Co., Schenectady, N. Y. A 32-page illustrated catalog on "Electric Heat in General Electric Factories."

Sullivan Machinery Co., Chicago, Ill. A 32-page illustrated catalog describing Sullivan portable electric hoists, single and double drum, 10 to 35 h.p.

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Small Drill Steel Sharpener

The Gardner-Denver Co., Denver, Colo., has just announced a new small size drill steel sharpener. This new sharpener has been designated as their Model DS-3. It is a twin cylinder machine in which the manufacturers claim to have developed a greater clamping power than any similar machine now offered and one which is faster in operation without slamming or pounding itself to pieces.

New Orton $\frac{5}{8}$ -Yard Convertible Shovel

The Orton Crane & Shovel Co., Chicago, Ill., has brought out the new Model "A" convertible $\frac{5}{8}$ -yard shovel. This is an exceptionally fast machine; its light weight, small over-all clearances and high mobility make it particularly suitable for excavating and grading contractors, material yards, industrial plants and similar applications.

Flexible crawling treads of the spring type distribute the weight when the machine travels over uneven ground, logs or other obstructions. The Model "A" can also be furnished with road wheels or for mounting on standard auto-truck chassis. Power is furnished by a heavy-duty 53-horsepower Hercules motor, which is provided with an electric starter as standard equipment.

The Model "A" can be furnished with shovel, crane, dragline, ditcher or skimmer attachment, and can be changed from one to any other in the field in less than two hours. The Model "A" crane has a lifting capacity of 6 tons at a 12-foot radius, and, when equipped with a standard 30-foot boom, handles a $\frac{1}{2}$ -yard bucket throughout its operating range. Booms 35 or 40 feet long can be furnished for hook operation.

The patented Orton "T" head on the ditcher attachment gives maximum pull back when the dipper stick is nearly horizontal, and minimum pull when the scoop is in a digging position. This arrange-

ment affords great digging power and also serves to snap the scoop back quickly when dumping. Two drums mounted on the boom, one on the top leading to the hoist drum and the other leading to the scoop, eliminate a sheave at the



GARDNER DENVER SHARPENER

scoop, and give a straight, direct pull, thus securing maximum digging power and depth of cut, and also preserving the cable.

The dragline has a 30-foot, lattice-type boom, and the fair-leader slides so as to give the most direct lead possible to the drum, being carried on a bronze-bushed, cast-steel lead sheave, with guard sheaves properly balanced so as to produce a minimum amount of wear on the cable. It handles a bucket with a capacity of $\frac{1}{2}$ cubic yard.

The Model "A" skimmer is provided with a steel boom, from which the scoop is suspended by means of bronze-bushed steel rollers. It has an effective length of travel of 11 feet, and the scoop has a capacity of $\frac{1}{2}$ cubic yard, with a width of 30 inches, although special widths can be furnished.

Riddell New Model Grader

The W. A. Riddell Company, Bucyrus, O., has added to its line of road graders a new model known as the BM, and has lately started shipping this grader from the factory, at Bucyrus, Ohio. The solid and strong frame construction which characterizes all other WARCO graders, is a feature of the BM. Power is furnished by a McCormick-Deering 10-20 tractor.

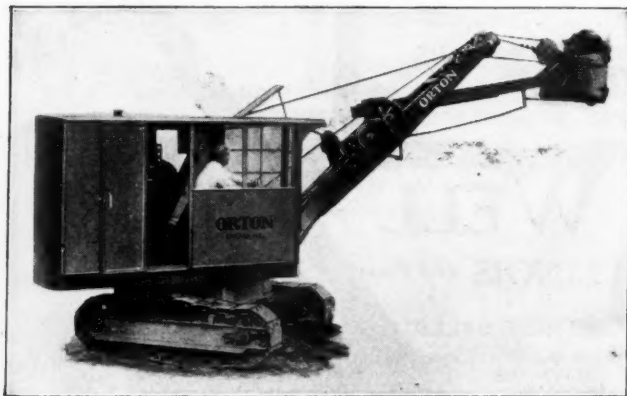
The model BM is center controlled, and is, of course, one man operated. Designed principally for maintaining, being a light weight machine, it is also adapted for general grading.

Healey Catch Basin Cleaner

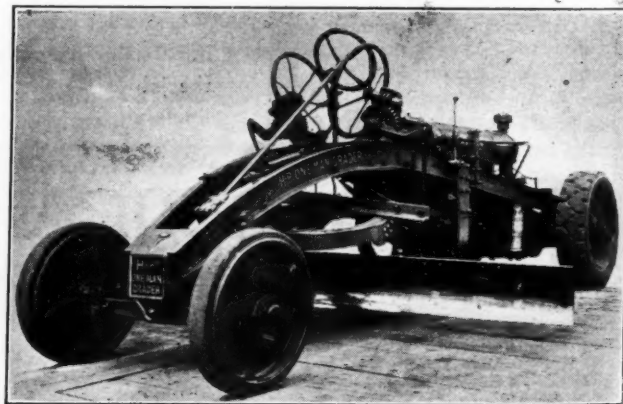
P. J. Healey, Jersey City, N. J., manufactures the Healey catch basin cleaner. This machine may be used in conjunction with a tractor, or it may be mounted on a truck. The power necessary for operation is derived direct from the motor by means of a chain drive power take-off. The Healey cleaner is especially designed for removing mud, stones, sticks and debris from sewer catch basins, and is made to withstand hard usage.

The Healey special interchangeable blade bucket furnished with the outfit is a digging bucket and will work into sand, gravel or other heavy material. Operation is through two levers and two brake pedals, which control the raising and lowering of the bucket; while a third lever, controls the swinging boom. The ordinary hoist speed, with 500 pound load is 50 feet per minute.

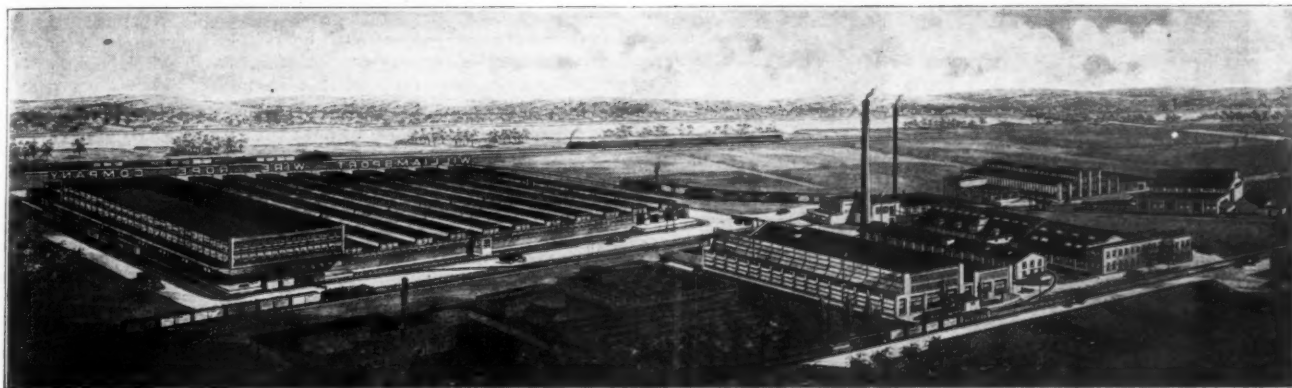
This machine is in use in a number of cities, including New York; Scranton, Pa.; Jersey City, Newark, Kearney, Bloomfield, Irvington and Perth Amboy, N. J.; Bergen County, N. J.; N. J. Mosquito Extermination Comm.; Passaic Valley Sewer Comm.; Brookline, Brockton, Revere, Fall River, Cambridge and Boston, Mass.; and Providence, R. I.



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The Universal "35" Crane and Shovel

The Universal Crane Company and The Thew Shovel Company, both of Lorain, Ohio, announce the Universal "35," a new $\frac{1}{2}$ -yard convertible crawler crane and shovel. These companies have combined in this new machine the Universal superstructure and the Thew center drive crawler. The resulting unit is offered with a complete range of inter-

ter drive shovel on the Universal 35 is of the most simple design, a shipper shaft, running in bronze bearings, a shipper shaft pinion and a cable winding drum compose the entire crowding mechanism.

This shovel attachment, and a series of other attachments, such as the crane, clamshell and dragline booms, skimmer scoop, ditcher shovel and back digger are all readily adaptable and interchangeable on the Universal 35 superstructure with-

out any changes to machinery back of the center pin. The hoist shaft is equipped with two drums, separately driven, which are grooved for improved cable life, and are used for any of the various attachments without use of lagging, etc.

The superstructure is the same as the Universal Crane Company has built for about ten years for motor truck mounting. All the machinery parts are grouped

well back of the center pin, thus acting as its own counterweight and enabling lifting the maximum weight with the minimum dead weight. Due to this balanced design, the Universal 35 is one of the lightest in weight for its capacities and operating ranges. As a crane, it lifts seven tons at 10-foot radius, easily handling a $\frac{1}{2}$ -yard clamshell or dragline bucket or a 1-yard backfiller board. The operator's seat is located at the extreme front of the turntable with an unobstructed view of his work at all times.

All controls are conveniently grouped about the operator's seat. Easier operation is obtained by replacing one hand

lever with a second foot pedal so that three hand levers and two foot pedals control all major operations. The swinging power has also been increased about 27% over the previous models, giving a full revolving swing speed of 4.8 r.p.m.

As on previous Universals, the new Universal 35 is adaptable to several mountings in addition to the center drive crawler. These include the five-ton or heavier motor truck, heavy duty trailer, railroad flat car, etc. The superstructure is readily transferable to and from any of these mountings.

Western Snow Plows

The Austin-Western Road Machinery Co., Chicago, Ill., manufactures western snow plows in both straight blade and "V" shaped types, both of which can be mounted on any two-ton or larger motor truck. These types are convertible; in other words, both types of blades fit on the same general framework—the substitution of one blade for the other being but the work of a few minutes—and the operator who does not have constant use for both types of blades, but who is likely to need first one and then the other at some time during the winter, is thereby relieved of the expense of purchasing complete plows of both types.

The straight blade Western Snow Plow has a 10-foot moldboard made of 5-16 inch x 6-inch steel, flanged at the top and bottom to strengthen it laterally, and provided with a removable 6-inch cutting edge or bit which gives the blade a total height of 21 inches. The blade is reinforced vertically by steel angles, and longitudinally by a $3 \times \frac{1}{2}$ angle to which is fastened the blade circle. When set at the normal plowing angle of about 30 degrees this 10-foot blade cuts a path about 8 feet wide, and, of course, throws all of the snow to the same side. The blade is properly shaped to roll rather than push the snow, and all the rivets in



WESTERN SNOW PLOW

changeable attachments including clamshell and dragline booms, shipper shaft and ditcher type shovels, back digger and skimmer scoop.

The center driver crawler mounting is manufactured under patent rights granted by the Thew Shovel Company and embodies all the features of this type of crawler, now used as mountings for the "Lorain 75" and "Lorain 60" shovels and cranes. None of the crawler driving mechanism carries any load, except driving load and all the driving mechanism runs in oil in a crankcase that permits 11 inches clearance beneath the crawler truck. Jaw clutches, sliding on square action shafts, engage the crawler for steering or travel. Two speeds are available for travel, 0.4 m. p. h. in low gear, climbing a 35% grade and 2.0 m.p.h., or five times as fast in high gear, climbing a 12% grade. With the travel clutches set in neutral, the unit can be towed easily by an unloaded $3\frac{1}{2}$ ton motor truck.

The center drive principle is also incorporated in the $\frac{1}{2}$ -yard shipper shaft shovel offered on this unit, which is the first $\frac{1}{2}$ -yard shovel built on this principle. By placing the shipper shaft farther forward additional reaches and clearances are obtainable, giving the greatest operating ranges and clearances possible with this length of dipper stick and boom.

The boom is 18 feet long, of plate girder construction out to the shipper shaft, and lattice construction from this point out to the boom head. The dipper stick is 14 ft. 4 inches long and is an all steel, welded rectangular section. The dipper stick rides between two large circular bearings which strengthen the boom and give lateral support. These bearings also furnish a machined track for a six wheel roller type dipper stick trolley which is used instead of the usual yoke. The cen-



UNIVERSAL "35" SHOVEL



CERTIFIED EARNING ABILITY

THE economy of Federal transportation is an actual demonstrated fact. Of all the Federals built, 72% are taken by men and firms who know Federals through the *ownership* of Federals. These successful fleet operators *keep accurate records* of their transportation costs. That they continue to standardize on Federals is a recognition of Federal's Certified Earning Ability as one of the biggest factors in profitable commercial haulage.

THE FEDERAL MOTOR TRUCK CO.
5848 Federal Ave. Detroit, Mich., U. S. A.
"Leading Specialists in Commercial Transportation"

**ACTUAL
MEASURED
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ASK for the "Federal System of Truck Expense Control" that is doing so much to lower haulage costs in every line of industry. No obligation whatever.

FEDERAL TRUCKS

ALL SIZES—FOURS & SIXES

(201)

When you want catalogs—consult the *classified* INDUSTRIAL LITERATURE section, page 59

the face of the blade have countersunk heads to provide an absolutely smooth surface, which does not interfere with the movement of the snow as would projecting rivet heads.

The "V" shaped blade cuts a path 8 feet 4 inches in width and, of course, throws the snow from the center to both sides. The blade is 34 inches high including the removable cutting edge or bit, which takes all the wear and is made in two pieces, one for each side of the "V." A replaceable steel nose casting fits over the blade and bits and stands the greater part of the abuse to which the "V" shaped type of plow is quite likely to be subjected.

New Novo Blower Outfit

The Novo Engine Company, Lansing, Mich., recently designed and built a new small blower outfit for the city



AUSTIN DUAL-DRIVE GRADER

of Lansing, to clean dirt from cracks in the pavement preliminary to pouring tar. The success of this first outfit was so marked, and resulted in such worth while savings, that the blower is now available for use by state, county and city engineering or highway departments having charge of road maintenance and repair work.

It is claimed that with this outfit one operator does as much as two sweepers and does the work twice as well. By eliminating all dust from the cracks, a better bond is made between the tar and the asphalt. In addition, the outfit may be used for blowing water from expansion joints and on many other similar jobs.

The new outfit consists of a Novo Model GU 2 H.P., single cylinder, hopper cooled, Roller Bearing Engine direct connected through two to one gearing to a No. 17 Connversville Blower. The complete outfit is mounted on a channel frame truck, with welded tubular spreaders. The blower has a discharge of 35 cubic feet per minute. To provide proper pressure an ordinary garden nozzle is attached to one end of the hose. Complete information regarding this new outfit can be obtained by writing direct to the Novo Engine Company, Lansing, Michigan.

New Austin Dual Drive Motor Grader

The Austin-Western Road Machinery Co., Chicago, Ill., has brought out a new dual drive grader.

The four-wheel drive on this grader furnishes the valuable features of a crawler tread without loss of power, excess friction or greatly reduced speed. The entire weight of the McCormick-Deering 10-20 tractor is carried on the four drive wheels rather than on the frame of the grader.

The extra weight on these drive wheels, together with the increased ground contact gives greater traction and allows the full power of the motor to be utilized. While the four drive wheels are regularly fitted with

6-inch tires, 10-inch tires which provide twice as much bearing surface as is provided on ordinary graders can be obtained.

The four areas of driving contact make it possible for this grader to get over soft ground and out of slippery or wet holes. The four distinct areas are separate from each other so that if one or two wheels runs onto a dif-

ficult spot, there will still be two or three wheels left on hard ground to carry the machine through. The reduced pressure per wheel with the four drive wheels, even though the total weight is greater, by lessening the tendency to get stuck makes it possible to get out on the road sooner after a storm or earlier in the spring than can be done with the two-wheel drive graders.

The front end of the tractor is carried by a spring support on its own drive wheels and axle instead of by the frame of the grader which is pivotally connected by heavy rocker beams with the rear axle. This gives the tractor flexibility and freedom

to move up and down inside the grader frame as uneven road surfaces make such movements necessary, using the rear axle of the tractor as a pivotal point.

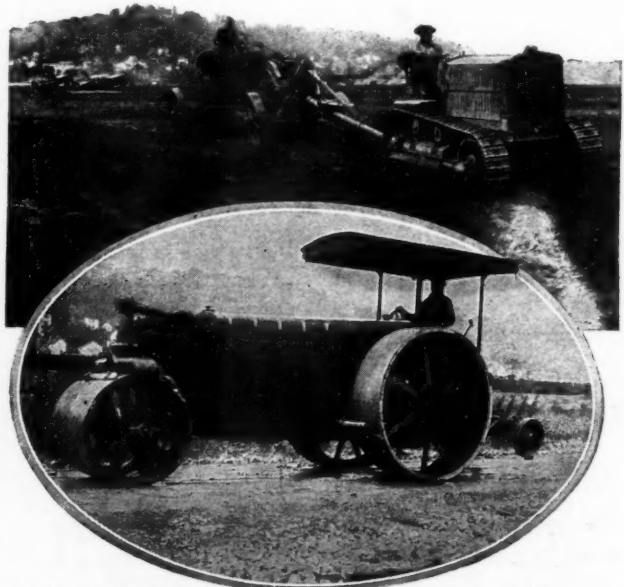


NOVO BLOWER OUTFIT

Carbon Dioxide Gas for Extinguishing Fires

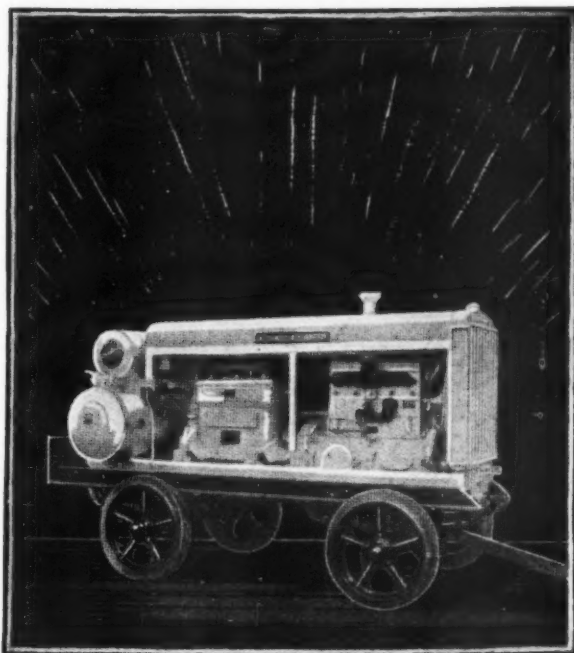
The American-LaFrance and Foamite Corporation now offer a system of carbon dioxide protection against fire known as the Alfite System. The Alfite System employs an inert gas known as Alfite Gas confined in a liquid state in metal cylinders under a pressure of 900 to 1,000 pounds. When the system is placed in operation a plunger ruptures a copper disc, used to seal the gas in the cylinder, and permits the gas to pass through piping to nozzles located at the fire. Here the gas is liberated into the room or space being protected, where it expands and dilutes the air so as to smother the flame.

The system may be operated manually, semi-automatically or automatically. A variety of operating devices are available, thus giving the system a flexibility



GALION ROAD MACHINERY AT WORK ON THE LUNKEN AIRPORT, CINCINNATI, O.

PRESTIGE BUILT BY PERFORMANCE



When you buy an M-W "AIR KING" you buy the utmost in Portable Air Compressor ability. You buy a machine that is always ready for work—under any and all operating conditions—under any service you may demand of it.

Designed and built by engineers who know what is most needed in Air Compressors, the "AIR KING" is a machine you can purchase with confidence and operate with satisfaction. Displacing from 5 to 50 men, the "AIR KING" introduces unbelievable economy over a period of years—a fact proven by the

largest public utility companies in the United States.

Outstanding features—its internationally proven Worthington Air Compressor; its famous Laidlaw Feather Valves; its powerful Wisconsin Engine; stamp the "AIR KING" as a machine whose quality is as dominant as its rugged performance.

The "AIR KING" is made in 110, 210, 280 and 330 cu. ft. sizes—in "Towabout," Railcar and other suitable mountings. A fully illustrated catalog complete with mechanical details is yours for the asking.

(P. S.—The City of Philadelphia now owns and operates seven M-W Compressors.)

METALWELD, Inc.

26th & Hunting Park Ave., Phila., Pa.

Dealers in all principal cities



Metalweld-Worthington *Portable Air Compressors*

enabling it to be applied to widely diversified conditions.

Air diluted with 17% of Alfite gas is sufficient to extinguish flames but as a factor of safety the Alfite System is designed to provide 35% dilution of the air in the space being protected. Alfite gas is not toxic. It does not damage fabrics, machinery and the like. Alfite cylinders can be kept in cold temperatures for the liquified gas does not freeze. It does not deteriorate. It is inexpensive.

Allis-Chalmers Tractors for Snow Plows

The Allis-Chalmers Monarch "50" and "75" tractors have been equipped for winter work with fully enclosed weather-proof cabs, constructed to keep the operator warm in the most inclement weather conditions, with full-vision glass panes offering maximum visibility. Special easily detachable and self-cleaning ice and snow grousers are provided to give positive traction for snow removal and winter logging work; or tracks with grousers cast integral can be furnished. These models have great reserve power and are especially adapted for snow removal work. Various makes of heavy "V" type and rotary plows are easily attached. Complete details of these models can be obtained by writing for the booklet "The Removal of Snow" to Monarch Tractors Corporation, Springfield, Illinois.

Grouting Rock Seams

Dravo Contracting Company, of Pittsburgh, Pa., has recently associated itself with the Francois Cementation Co. of London for the use of the plant and technical staff of the latter company, which is established as the cement grouting expert of the old world. Originally developed to meet mining conditions, the Francois Cementation process has rapidly extended into the field of civil engineering, and was recently used in restor-



ROCK SEAMS FILLED BY FRANCOIS PROCESS

ing St. Paul's Cathedral, London, checking the subsidence of the leaning tower of Pisa, sealing dam leakage in Spain and elsewhere. It has been used to prevent leakage in tunnels, and more particularly, perhaps, leakage in dams and reservoirs by a thorough pre-treatment of the strata prior to construction.

The process consists in injecting a liquid cement mixture at a high pressure into strata so that the finest fissures are filled in such a way as to render them impermeable. The liquid cement is moved continuously by pumps through pipes and bore holes to the desired spot and kept under constant and effective control, the pump easily and quickly developing pressures up to 3,000 pounds per square inch if necessary.

Chemicals lubricating in their action are employed to insure the cementation of hair cracks and fine fissures and to assist in sealing the pores of porous rock.

INDUSTRIAL NOTES

John A. Manley, who has been manager of sales development for Fairbanks, Morse & Company Chicago, for the past three years, has been elected vice president in charge of sales.

NATIONAL EQUIPMENT CORPORATION ACQUIRES PARSONS COMPANY AND INSLEY MFG. COMPANY

The National Equipment Corporation, of Milwaukee, has recently acquired the

Parsons Company of Newton, Iowa, and the Insley Mfg. Company, of Indianapolis. Both companies will continue under their present management as divisions of the National Equipment Corporation; H. C. McCardell, president of the Parsons Company and W. H. Insley, president of the Insley Mfg. Company, becoming vice president and directors of the National Corporation.

The National Equipment Corporation now owns four companies — Koehring

ing Company, T. L. Smith Company, Insley, and Parsons, with total assets of \$9,000,000 and 1928 sales close to \$10,000,000.

The officers and directors of the corporation include Philip A. Koehring, president and treasurer; W. J. Koehring, W. H. Insley, Harold E. Smith, and H. C. McCardell, vice presidents; W. J. Zimmers, secretary; and J. E. Uihlein, R. A. Uihlein, Willits Pollock, and J. W. Kieckhefer, directors. The divisions of the National Equipment Corp. are operated as independent units, with close cooperation in engineering matters, standardization of production methods, warehousing, service, and other angles where savings can best be realized.

The Koehring Company was organized in 1906 by William J. Koehring, Philip A. Koehring and Richard Kiel, to manufacture concrete mixers, paving machines, power shovels, cranes, and draglines; the sale of these having increased from \$686,642 in 1917 to \$5,542,998 in 1927. The T. L. Smith Company was organized in 1900 by T. L. Smith, who brought out his first tilting-drum concrete mixer in that year. The W. H. Insley Mfg. Company was organized by Mr. Insley as a steel fabricating and jobbing business; but its most profitable specialty now is steel hoisting towers and chutes for concrete pouring. Four years ago Mr. Insley introduced a half-yard shovel and crane, the shovel being complementary to the larger Koehring machines. The Parsons Company was founded by George Parsons whose interest was later purchased by H. C. McCardell, who has for some years been its president and general manager. It manufactures trench excavators for digging trenches of various sizes and depths.

RYAN AND C. D. EDWARDS MFG. COS.

The Ryan Mfg. Corporation, of Chicago, and the C. D. Edwards Mfg. Company, of Albert Lea, Minnesota, announce the consolidation of their sales organization effective November 1, and it is understood that this looks to the eventual consolidation of manufacturing and other activities of the two companies. The Ryan Company makes a motor-controlled blade grader for heavy grader work, berm shaping, bank cutting and road widening work, with blade lengths from 8 to 14 feet and weighing from 6,000 to 12,000 pounds. Edwards & Company has been manufacturing graders and light patrols weighing from 1200 to 4200 pounds and recently has added a dual-blade pusher type motor patrol.

Very little change will have to be made in the two distributing organizations. Rogers E. Edwards, heretofore secretary and treasurer of the Edwards Company, has been elected vice-president of that company and also vice-president of the Ryan Company. He will direct the sale activities of the two corporations, which now have representation in thirty states and contemplate representation in the others.



MONARCH "75" EQUIPPED FOR SNOW WORK

Again Cleveland Welcomes You —

A GAIN this year the city of Cleveland will be the gathering-ground for the great road-building fraternity at its **TWENTY-SIXTH ANNUAL CONVENTION and GOOD ROADS SHOW!** For five big days it will be the mecca of the highway industry. For five big days it will deal out pleasure and profit to all who come.

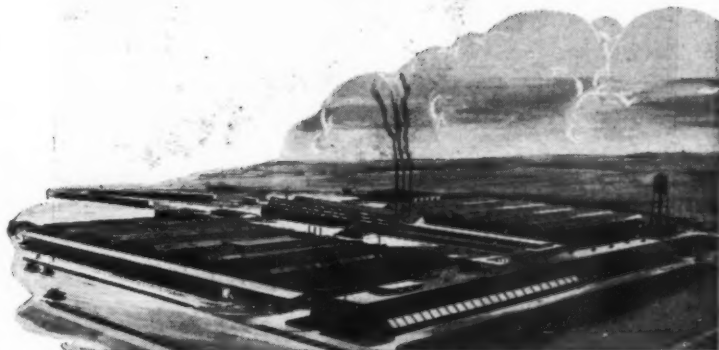


*Public Hall — Place of the Convention and Road Show
January 14th to 18th, Cleveland, Ohio*

Everything is in readiness — for a successful convention, a great exhibition and a whale of a good time. Plan to be there — January 14th to 18th — and see the greatest array of road-building, maintenance and contractor's equipment ever assembled at one point.

Again Cletrac Invites You!

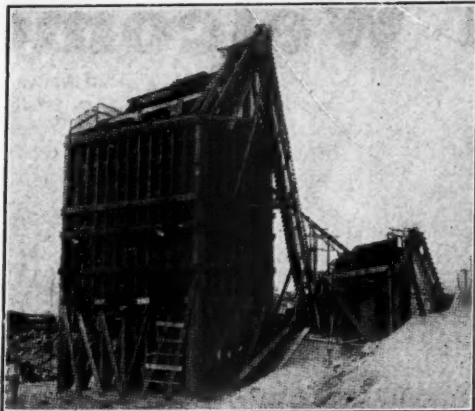
CLEVELAND is the home of **CLETRAC CRAWLER TRACTORS** and again this year the Cletrac factory extends you a special invitation to visit its large plant while at the convention. Special entertainment is on the program and special demonstrations of Cletracs with various types of equipment will be held. Our factory exhibit is one in which many other manufacturers of contractor and road building machinery are taking part.



*The Cletrac Factories and Office
19300 Euclid Ave., Cleveland, Ohio*

See the big show and the Cletrac exhibit at the Public Auditorium by all means — but don't fail to visit the Cletrac Factory, where big preparations have been made for your visit.

The Cleveland Tractor Co.
Cleveland, Ohio



DEPENDABLE SERVICE

Any Equipment Will Undoubtedly Give Satisfactory Results for a Short Time, but—

RELIANCE UNITS

**CAN BE DEPENDED UPON FOR
CONTINUOUS, UNFAILING SERVICE**

Our products have established an enviable record of Performance under the most exacting conditions. The First Reliance Crusher, built in 1883, is Still in Active Operation at Calvary Cemetery, Brooklyn, N. Y.

**WE OFFER A COMPLETE LINE OF
Road Building, Maintenance, Quarry and Gravel
Handling and Washing Equipment**

*With your permission we shall be glad to
mail you catalogue and prices.*

**UNIVERSAL ROAD MACHINERY CO.
KINGSTON, NEW YORK**

The Public Demands Open Highways

If your Highway Department is
equipped with

FRINK SNO-PLOWS

You know that you are ready to meet
that demand.

**19 Models—One of which
fits your truck or tractor**

Ask for Catalog No. 27

CARL H. FRINK, Mfr.
Clayton, Thousand Islands New York



Frink Sno-Plow and Leveling Wing
attached to 2½ ton truck

ASPHALT PLANTS PORTABLE, STATIONARY, RAILROAD, SAND DRYERS

Either Direct Heat or Internal Flame

The
J. D. FARASEY MFG. CO.
CLEVELAND, OHIO

SWEET'S STEEL POSTS

The Post with the patented
riveted lug--
That saves time and trouble.

Write for complete information

SWEET'S STEEL COMPANY
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No. 1 of a Technical Series

Which Is of Greater Importance

STRENGTH

or

DURABILITY?

Most specifications covering concrete pipes stress the strength to withstand crushing load as the most important requirement.

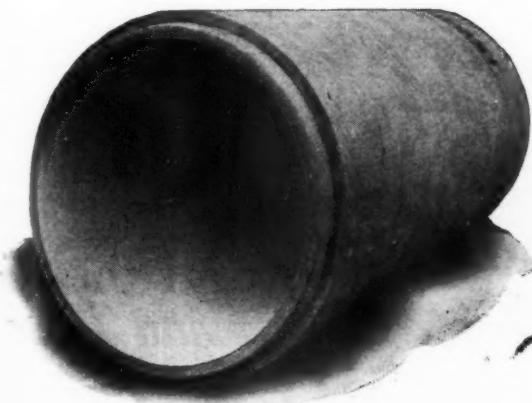
*Improvement in
Quality will result
in Increased Use of
Concrete Pipe*

While there should be no let-down in the specified strength, but rather an increase, strength can be obtained with a concrete pipe of low quality otherwise.

With strength requirements easily met, the Purchaser is principally concerned with the durability or life of his pipe.

The durability of any concrete structure exposed to water is dependent on its density, the measure of which is its capacity to absorb water.

Why countenance an absorption of 8% when it can be kept below 3%?



Made with Cone Joint in Larger Sizes

**HIGH DENSITY, LOW ABSORPTION,
LONG LIFE PIPE**

is readily obtained with the

**MOIR-BUCHANAN
CENTRIFUGAL PROCESS**

*If you are interested in rights to
use this process write to*

ASPHALTO-CONCRETE CORPORATION

1440 BROADWAY, NEW YORK CITY

Warrenite-Bitulithic Pavement

—“A WARRENTed Product”—

BECAUSE IT PAYS—

If for no other reason, you should use this pavement because it *pays*. Its fine appearance, its smooth surface, its rugged body, its long life, and its trouble-free performance are added reasons,—but aside from them,—it is good business to use it because it defies competition on the basis of cost per mile per year.

Warren Brothers Company

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International Highway Engineers and Contractors

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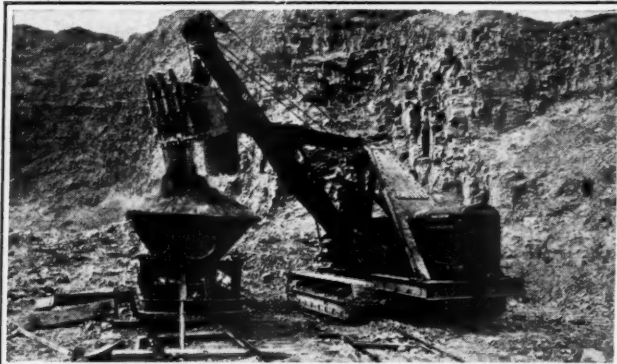
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Leader of the Small Shovel Field BAY CITY TRACTOR SHOVEL

Operates Shovel, Clam, Dragline or Trench Hoe
¾ swing—3 speeds—1 to 4 mi. per hr.

The Choice of
CITY, STATE and COUNTY
Road Commissions and Public Works Boards

Speed! Capacity! Earning ability!

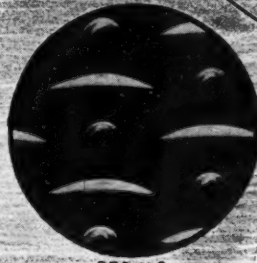
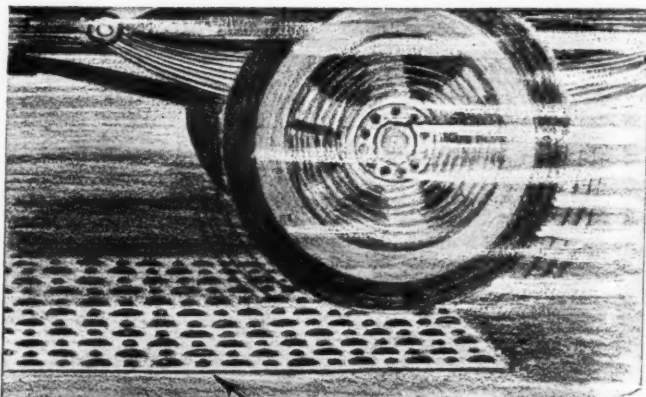
Other features include—¾-yd. bucket; a husky McCormick-Deering Power Unit; Timken and Hyatt Bearings; big, full crawlers; one-man operation; ten-ton weight, scientifically distributed to insure correct balance—no counterweights.

Our new catalog tells about the BAY-CITY'S features and why they reduce pit costs. Send for your copy now.

BAY CITY DREDGE WORKS - Bay City, Mich.

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FULL OR PART CIRCLE SHOVELS—CRANES—EXCAVATORS



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**"KNOBBY"
NON-SKID**

FLOOR PLATE

*This
Plate will
stand the
Wear and Tear*

of the most severe and constant traffic. It is used not only for permanent work, but is also used quite extensively for temporary repair work.

Send for our latest bulletin.

Central Iron & Steel Co.
Harrisburg, Penna.

Branch Offices in All Principal Cities

Helping to Solve the Nation's Sewage Treatment Problems

— — How Dorr Equipment is used at Syracuse



Dorr Clarifiers
Dorrco Screen Units
Dorrco Bar Screens
Dorr Detritors
Dorr Digesters
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SYRACUSE, although an inland city, is fortunate in having a large body of water nearby, available for dilution of treated sewage. The treatment required, therefore, is not so intensive as that at some other inland cities.

Four Dorr Clarifiers, illustrated above, continuously remove the settleable solids from the sewage which has previously passed through bar screens. The clarified effluent runs from the Clarifiers into Lake Onondaga, which is not used for drinking purposes; the solids are pumped to a point some distance from the plant, mixed with waste lime, and lagooned.

In the sewage treatment plants of more than 140 other cities, Dorr Equipment is installed to carry out the unit processes of screening, sedimentation and sludge digestion. These plants cover a broad range of climatic variations and sewage of widely differing characteristics is encountered.

Our Sanitary Engineering Staff will be glad to cooperate with consulting engineers and municipal officials who have a sewage treatment problem under consideration.

Write to our nearest office for Sanitary Engineering Bulletin.

THE DORR COMPANY ENGINEERS

247 PARK AVENUE NEW YORK CITY

INVESTIGATION TESTS DESIGN EQUIPMENT

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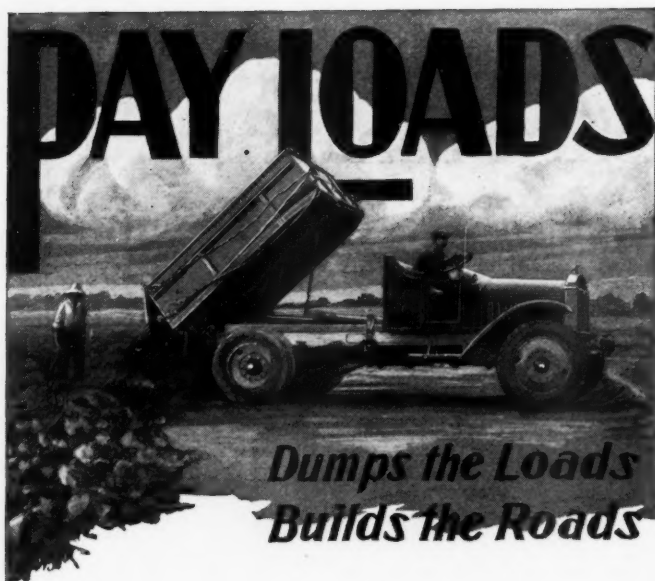
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All Good Roads come out of Dump Truck bodies. The better the body the more efficient the entire dumping unit.

The type of Wood All-Steel Body, selected for your particular requirements, saves time, lasts longer, increases the operating efficiency, reduces maintenance cost.

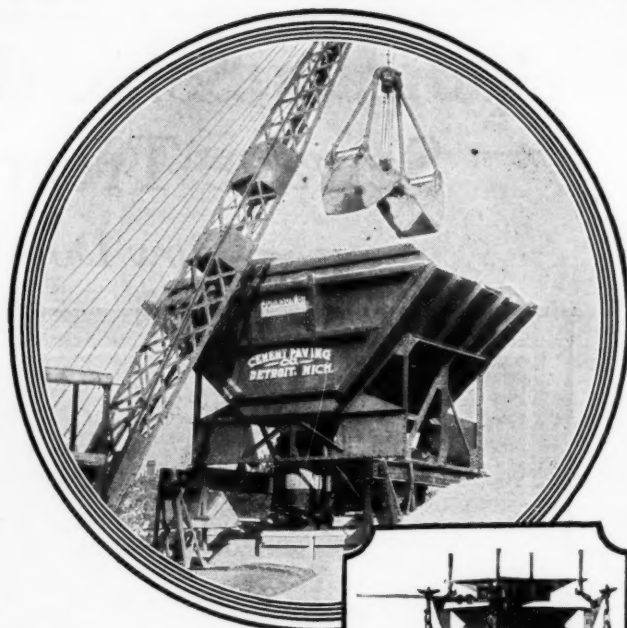
Truck manufacturers dealers and owners are pretty well agreed that the sturdy construction features of Wood Bodies are a guarantee of satisfactory performance and service—*until the last load is dumped.*

The Wood line is complete. A Wood Hoist and All-Steel Dump Body for every make, model and capacity of motor truck.

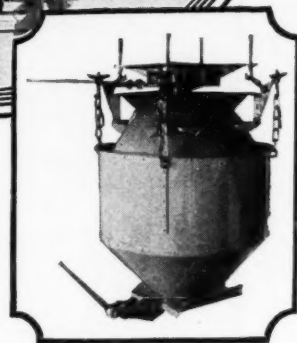
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Wood Hydraulic Hoist & Body Co.
Detroit Meet us at Good Roads Show
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**Johnson
Speed and
Accuracy
Mean
Greater Profits!**



Time saved on the job adds dollars to the profit column. Johnson Bins not only are speedy in operation but allow real time saving in erection or dismantling. Built in fully assembled steel units they are always ready for quick erection or dismantling when change of "set up" is required.

The speedy, simple operation of Johnson Batchers is one of the outstanding reasons for their wide popularity. Their construction assures a full discharge, they measure accurately, and meet every requirement of State Highway Departments.

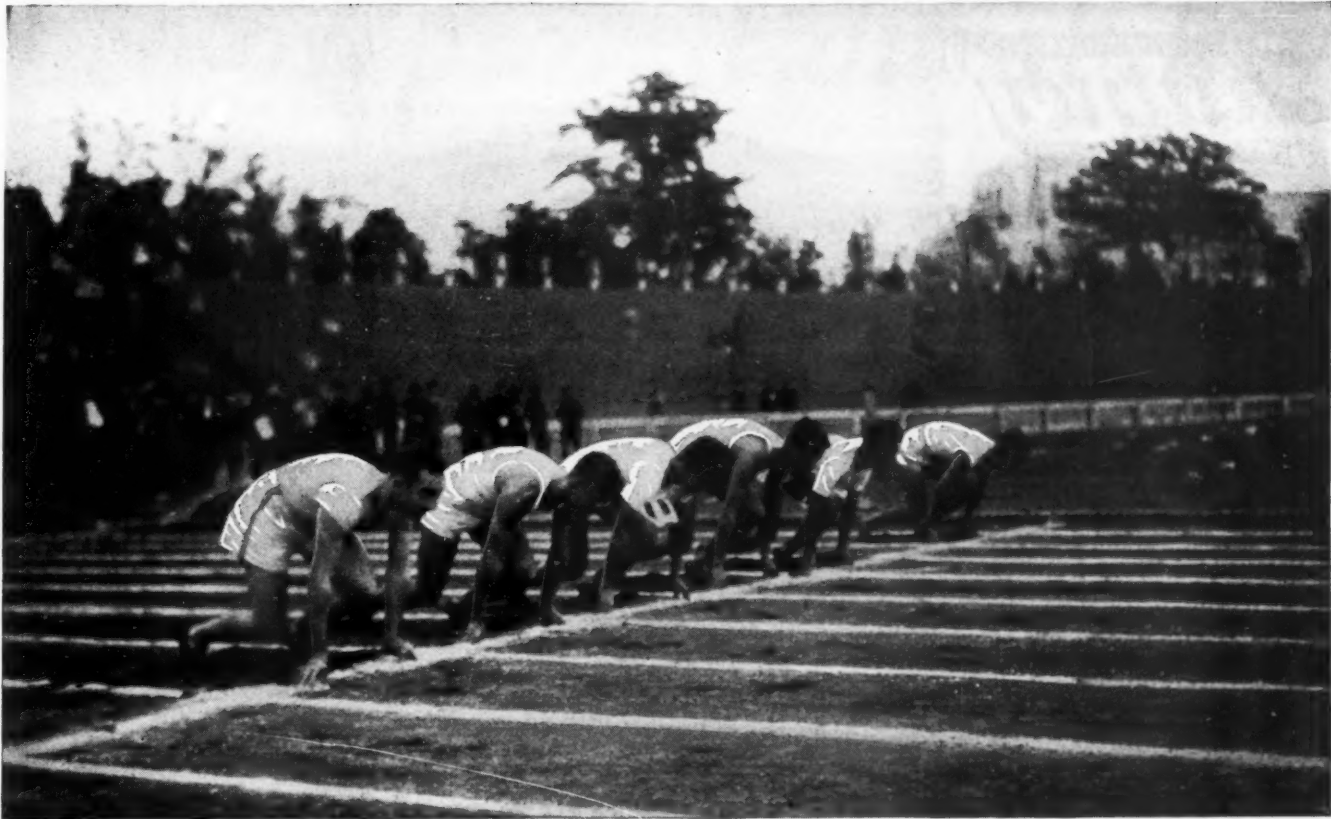


Johnson Scale Batchers simultaneously measure the material in each batch and indicate the weight of the volume as well—thus assuring a full yield of concrete, with no under-batching.

Write for complete information.

C. S. JOHNSON COMPANY
CHAMPAIGN, ILLINOIS





INTERNATIONAL NEWSREEL PHOTO

It isn't how they **START—**



A water meter is in for a long race when it goes into service for the first time. For months and years it must keep up the same accurate standards it starts with. If it doesn't do this, it can soon eat its head off by inaccurate measurements of water and cost of repairs.

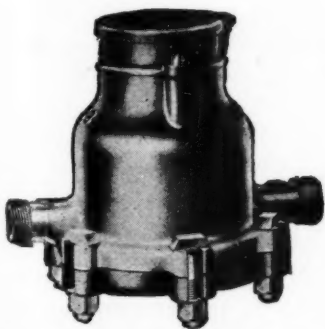
That is why a Hersey Water Meter can give an ordinary water meter a handicap of half its initial cost and still be the cheapest in the long run.

ter, and \$1.50 to \$2.00 there for testing and repairing it, and to this sum add the loss of registration accuracy which probably amounts to from 6 to 10 per cent and you commence to see how conservative the above statement is.

Today more than ever water department officials are turning to the Hersey Disc Water Meter — a revenue computer of the highest quality.

Add \$2.00 here for resetting a me-

Tests prove it to be the "cheapest" investment.



The Hersey Disc Meter is completely dipped-tinned, the best known protection against corrosion

Hersey Manufacturing Company, South Boston, Mass.

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WATER METERS

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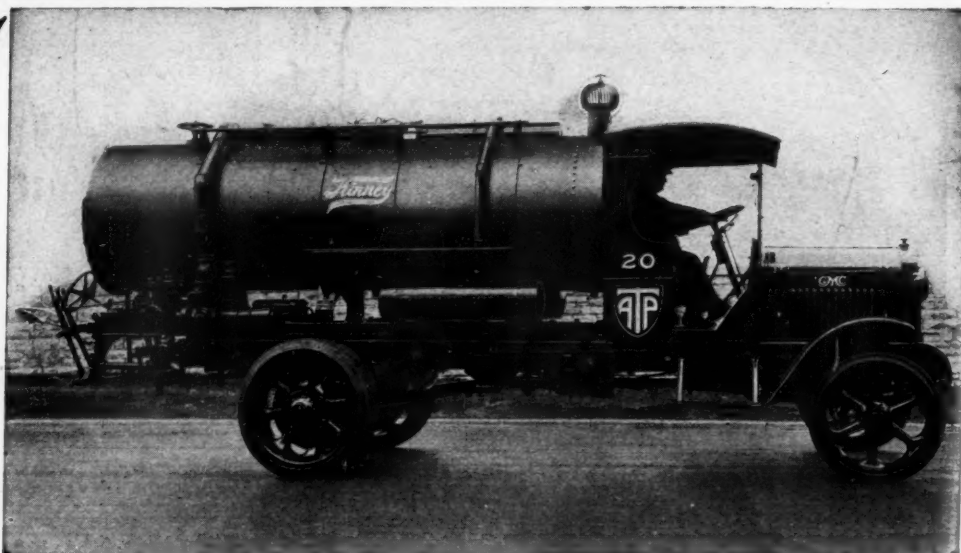
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Kinney
TRADE MARK
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**Time
Labor
and
Money
Saver**



The Kinney Heater and Distributor

Meets all specification requirements. Guaranteed to sufficiently heat and properly apply all varieties and grades of bituminous material for road construction and maintenance.

Kinney Manufacturing Company

BOSTON, MASS.

New York

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Wherever Snow Removal is a Problem

Your Galion Motor Grader does splendid work in road maintenance. It will also do splendid work in snow removal in moderate depths.

The blade alone will do good work but the snow plow or breaker is a very effective addition. Plan to use your motor grader for snow removal this winter.

Write for facts and prices.

The Galion Iron Works & Mfg. Co.
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GALION ROAD MACHINERY

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Use Your

GALION MOTOR GRADER The Year Round

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January 14 to 18, inclusive
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Let preproved durability

1906

Armco Culvert installed in Ohio, 1906. Today it is still "on the job". Engineering authorities who have examined this culvert state its condition indicates a life of 50 years or more.



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cut your drainage costs!

ECONOMY—lasting economy—in road building must be lower cost per year of service, for roads are built to endure. That is why the preproved durability of Armco Culverts is so important to every engineer and official who is concerned with road construction.



"Look under your roads"

There need be no question about Armco Culvert economy. You can prove it for yourself, right in your own territory, for Armco corrugated iron pipe has given up to 22 years of service in nearly every state and province.

Armco Culvert preproved durability does cut culvert cost. If you are interested in economy—lasting economy, get this evidence as proved in actual road service. Your name and address brings the facts.

Forty manufacturing plants throughout the United States and Canada assure you immediate service on drainage requirements, no matter where you may be.

ARMCO CULVERT MANUFACTURERS ASSOCIATION
MIDDLETOWN, OHIO

ARMCO PIPE

—preproved by twenty-two

*This statement can
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culverts of Armco
Ingot Iron purity
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%*

years' actual field service

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Present
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2 SPEED
A QUALITY

*The 2 speed Center Drive
 Crawler outmaneuvers
 them all! The Center Drive
 Shovel outreaches them all!
 The Universal Superstruc-
 ture outperforms them all!*

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1929
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ITY PRODUCT AT NEW PRICES

THE UNIVERSAL-35 combines 2 proven quality products, the Universal Superstructure and the Thew Center Drive Crawler into a new, quality built $\frac{1}{2}$ yard machine—at new attractive prices that will appeal.

Many new mechanical and money-making features—a 2 speed Center Drive Crawler, a powerful rope crowd Center Drive Shovel (readily convertible to Crane, Clamshell, Dragline, Skimmer, Backdigger) all of Universal's quality construction, all of Universal's money-making ability, all of Thew's 33 years of experience—Speed, Reliability, Strength—all these, and much more, are built into the UNIVERSAL-35—and are offered you at new attractive prices that make it "The Greatest Value in a $\frac{1}{2}$ yard Machine."

A copy of Bulletin 45-G fully describing "The UNIVERSAL-35" is ready for you. Fill in and mail the coupon today!

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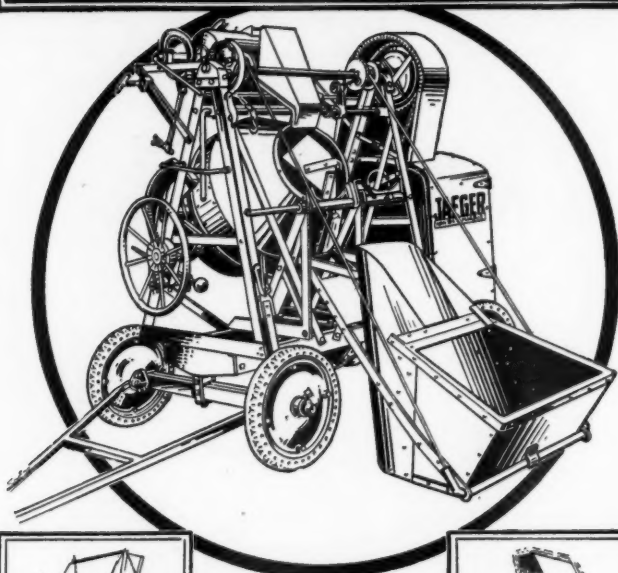
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Jaeger-Built, All-Steel, 100% Timken Bearing—FAST!

For the usual price of a half bag mixer you can get this Timken bearing, full one bagger, with Automatic Skip Shaker Loader, Accurate Measure Water Tank, "Flat Spot" Drum and 5-second discharge.

It's built of steel and forgings with semi-steel gears—light, portable and 50% stronger. Serviced by Jaeger stations in over 100 cities, no delay. Write for price and terms.



HEAVY DUTY NON-TILTERS 7-10-14-28 FT. SIZES

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to enjoy all the comforts of home at the utmost economy. Amid pleasant surroundings, with all the advantages of perfect hotel

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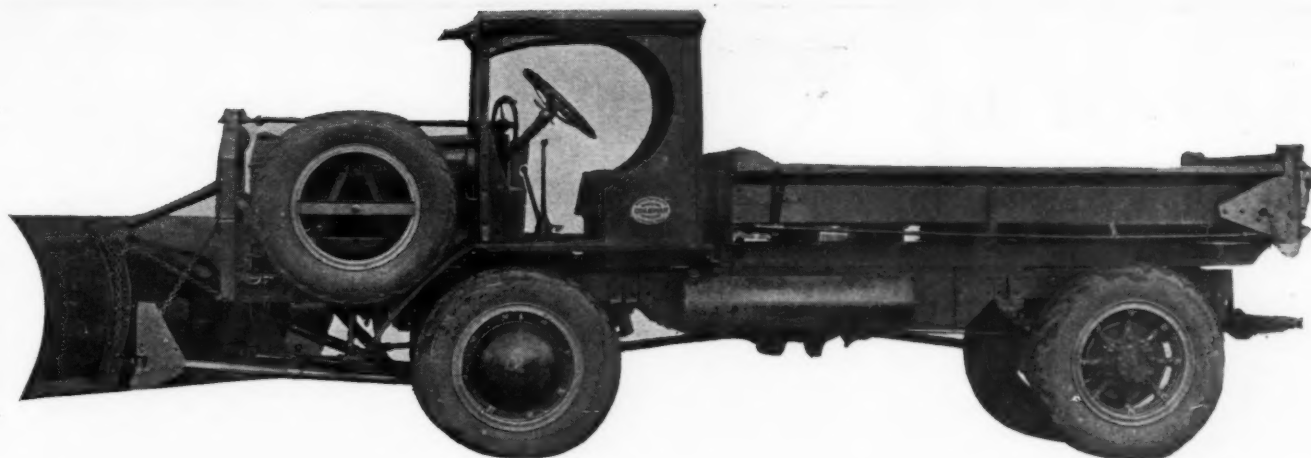
Martinique guests invariably experience the "best without extravagance." Rates start at \$2.50 per day—club breakfast 45 cents—special table d'hôte luncheons and dinners at moderate prices. On your next trip let us convince you.

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THE IMPORTANCE OF TRACTION AND *Steering Ability* in SNOW REMOVAL

When state, town and county officials and transportation companies select power units to clear roads this winter, one feature of these units will control more sales than any other. And that feature is **SPEED!**

Pushing a snow plow takes plenty of power, but to be able to use that power there must be **TRACTION!** In snow, the wheels always skid before the motor stalls. The Coleman Four Wheel Drive Truck has over twice the tractive power of the ordinary two wheel drive. Remember that *speed* in snow removal depends on *power* and *power* depends on *traction!*

Another factor that controls the speed of clearing roads is steering ability. When the plow gets off line and it is necessary to back up two or three times to get it straight, valuable time is being wasted. The secret of the remarkable steering

ability of the Coleman Truck in snow, is the fact that *one half of the truck's power is used to steer.* The front wheels are turned in the direction you want to go.

The rear wheels are still pointed in the wrong direction. The power that is applied to the front wheels pulls the truck in the right direction. The front wheels of the Coleman hardly ever skid sideways, because only half the power is pushing them in that direction.

And in addition the Coleman truck works the year round! Snow removal in the winter and all kinds of road maintenance the rest of the year.

The Coleman line is complete. There is a size for every possible snow condition. All standard plows from the largest rotary to the smallest speed plow can be easily mounted.

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Main Plant
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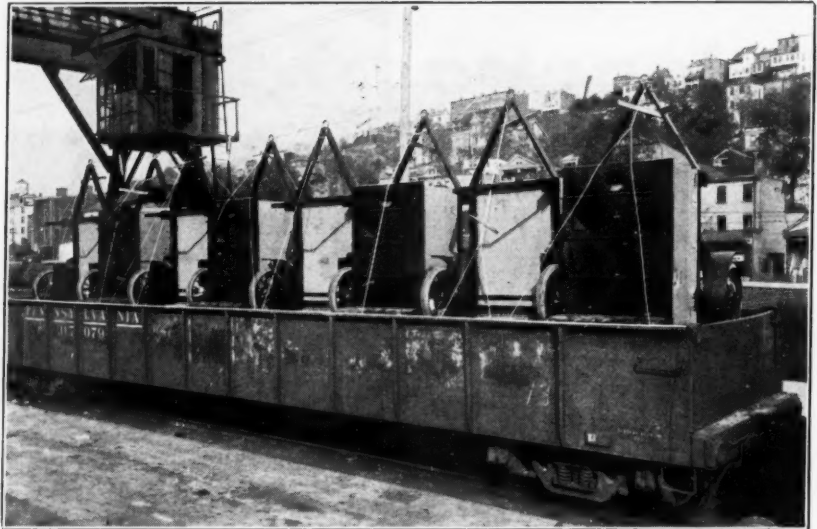
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FOUR WHEEL DRIVE

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Down in TEXAS

During the month of October, 1927, fifty Littleford Trail-O-Heaters, 300-gallon tar and asphalt kettles, each equipped with a Hand Spraying Attachment, left Cincinnati for Texas. They are now being used for highway maintenance by the highway department of the State of Texas. The No. 78 Trail-O-Heater is particularly well suited for Texas, where road equipment is subjected to long and hard trailing. In September of this year we received another order for thirty-eight more Trail-O-Heaters. Evidently Texas was pleased with the first lot.



The No. 78 Trail-O-Heater is one of fourteen standard types of tar and asphalt kettles included in our road and street maintenance equipment line; you will have no difficulty selecting a kettle particularly suited to your work. Write for our new catalog which shows and fully describes each outfit—We will see that you get a copy by return mail.

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452 East Pearl Street

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LITTLEFORD
ROAD & STREET MAINTENANCE
EQUIPMENT

EVERYWHERE



40 ft. 0 in. Portable Belt Type Conveyor equipped with shaker screen separating three sizes of materials and delivering one size into truck.

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offers you a
ROOM and BATH
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A room with both Bath and Shower \$3
Rooms for Two at \$3.50 and \$4.00

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"Just around the corner from Everything!"

The President
awaits your visit

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Yes

Know the Koehring!

YES—the new Koehring is new from charging skip to boom tip!

In speed of operation—simplified automatic actions and control — in swift, hungry eagerness in taking materials into the charging skip and putting quality concrete on the

subgrade, the new greater Koehring is beyond all question a new mighty *Master Money-Maker* for the Paving Contractor!

Also, in the mechanical detail and Koehring advanced Heavy Duty Construction it is the super *dreadnaught* of pavers!

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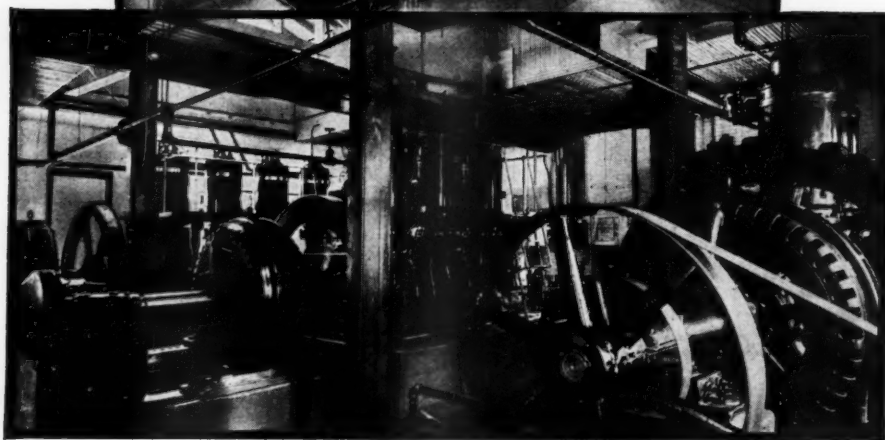
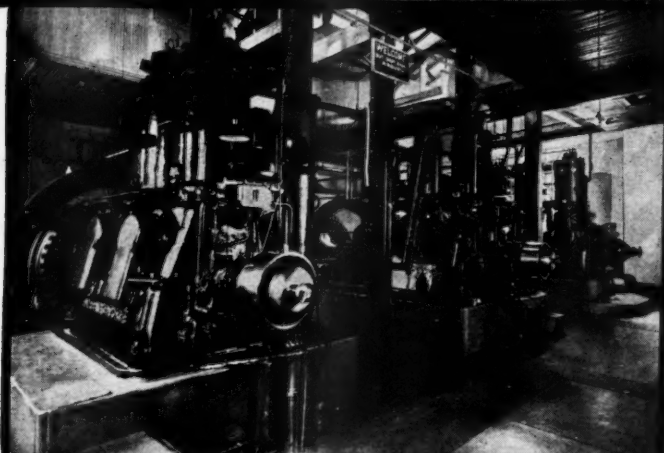
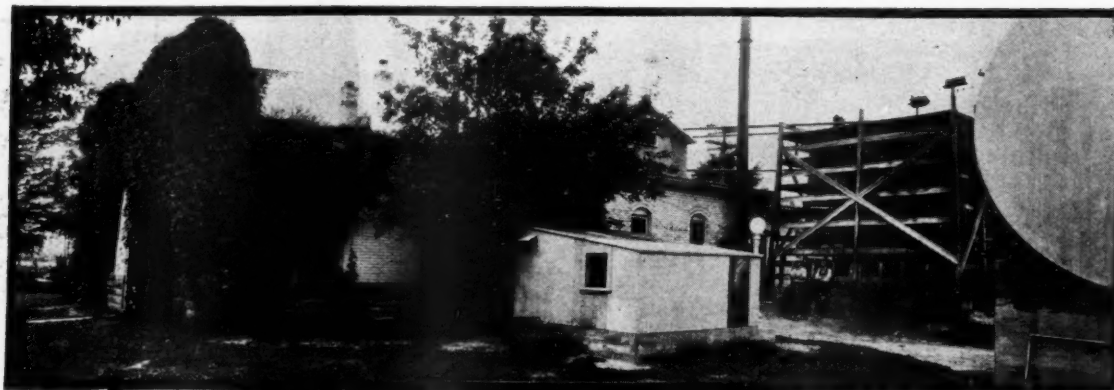
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A4960-1

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17 years of profitable



Above: the original engine room at Sebewaing is still in use. 490 hp. is now installed as against 70 hp. in 1911. At left: two views of the engine equipment of the Sebewaing municipal light plant. It now consists of 100, 150, and 240 hp. F-M Diesels.

F-M Engines are never junked!

The original engines from the Sebewaing plant are still in useful service. The 50 hp unit is in operation at Chatfield, Minn., and the 20 hp. is on a dredge near Sebewaing.

FAIRBANKS-M

When you want catalogs—consult the *classified* INDUSTRIAL LITERATURE section, page 59

the operation for

SEBEWAING, MICH.

F-M DIESEL EQUIPPED

MUNICIPAL LIGHT PLANT

*Increased from 70 to 490 hp. Showed
profit of \$10,000 for year of 1927*

The story of this plant's growth, which has been paralleled in other communities throughout the country, is one of regularly increased capacity to meet an equally regular increase in load.

From a 70 hp. F-M equipped plant, originally used to supply its street lighting system, the municipal light plant of Sebewaing, Michigan, has increased in seventeen years to a 490 hp. F-M Diesel plant. Last year it showed a profit of \$10,000.

F-M engineers will be glad to make a survey of your power and light problem without obligation on your part.

FAIRBANKS, MORSE & CO., Chicago

28 branches at your service throughout the United States

MORSE

**DIESEL ENGINES
PUMPS
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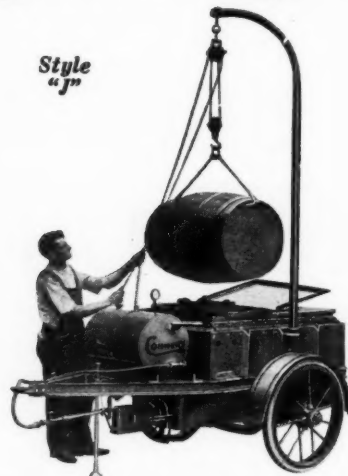
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Guard Your Highways!

Style "J," the handy oil burning patrol heater, will guard any highway with economy and efficiency. Something easy to handle and quick to heat. Equipped with standard roller bearings, grease cup insuring constant lubrication, Connery's Improved Springs, Connery's Improved Oil Burner and properly reinforced by Connery's Patented Ribs and angle iron. Handle made of 3" channel iron equipped with large cast steel pulling ring. Rubber tires and heat guards optional equipment and furnished at additional cost. Made in capacities of 50, 75, 100 and 165 gallons.

Style
"J"



CONNERY'S



Style "B-2"

HEAVY DUTY OIL BURNING HEATER

Style "B-2" was designed for road contractors and municipalities who require hot tar or asphalt in large quantities and need it in a hurry. This kettle is made in three capacities—300, 400 and 550 gallons—and will melt a batch of tar or asphalt in considerable less time than coal or wood.

We manufacture a full line of Tar and Asphalt Kettles, Oil Burning Kettles, Pouring Pots, Torches, Hand Spraying Attachments, etc. Send for our "Blue Book" illustrating our complete line.

CONNERY & COMPANY, Inc.

3900 N. SECOND ST.

PHILADELPHIA, PA.

ACCEPT NO SUBSTITUTE

Sterling



"perfect balance" — the load is carried over the wheel—not on the arms.

More capacity loads per man per day — means more work — more profit. This is one of the many reasons why Sterlings are found on more jobs. With a Sterling the man *pushes* the load—not *carries* it. This feature is not found in ordinary barrows.

Complete stock warehouses at Chicago, New York, Philadelphia, Pittsburgh, Cleveland, Detroit, St. Louis.

Leading Hardware and Equipment dealers have them.

STERLING WHEELBARROW COMPANY
Milwaukee Wisconsin

In
Chicago's
Beautiful
South Shore
District—
NEAR LAKE
MICHIGAN



COOPER-CARLTON HOTEL ... Chicago
Hyde Park Blvd. at 53rd Street

Restfully quiet, away from congestion, yet only an 8-minute ride to downtown by fast electric express. Beautifully-furnished, large, light, airy rooms, with private bath (both shower and tub) \$3 and upward per day. Unsurpassed dining room service at very moderate prices.

Two blocks from 53rd St. Station, I. C., M. C. & Big Four; short distance from Englewood 63d St. Station N. Y. C., R. I. and Nickel Plate. Write for Free Booklet.

F. H. Sweeney, Manager



Reconditioning Old Gas Lines with

McEverlast Protective Coatings and Wrapper—Applied Cold.

CORRODED—deeply pitted—this section of gas transmission line of the Industrial Fuel and Supply Co., affiliated with the Southern Counties Gas Co. of California, is being salvaged for years of further use. McEverlast electrolysis-proof coatings and wrapper do the trick—make old pipe lines like new ones—save the expense of new pipe!

The soil in which this pipe was buried is so strongly alkaline that it looks almost white. Yet engineers of this big gas company are convinced McEverlast Electrolysis Proof Coating and Wrapper will keep corrosion down to a minimum.

Eliminates Risk of Burns!—Permits Smaller Crews!

It isn't necessary to heat McEverlast coatings. This eliminates accidental burns—work interruptions—costly delays! This cold application allows smaller crews, lower expenses. McEverlast coatings composed chiefly of live Bermudez asphalt and Gilsonite, held in suspension by special process. Properly applied, they form maximum resistance to all forms of corrosion and electrolysis—leave a tough, smooth surface which won't crack or chip.

Some Extensive Users of McEverlast Protective Coatings

Southern California Gas Company; Shell Company of California; Pan-American Petroleum Company; Sun Oil Company; California Petroleum Company; General Petroleum Com-

pany; California Eastern Oil Company; Chanslor-Canfield Midway Company; Union Pacific Railway; Hercules Gasoline Company; City of Los Angeles, and twenty-one other cities in the Southwest.

MC'EVERLAST, INC.

(Formerly Everlasting Paint and Sales Co.)

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Withstand Remarkable Test

Pipe protected with one McEverlast Penetration Coat and two coats of Electrolysis-Proof, subjected to a continuous 90 day test with 6 volt potential, 30 days in 5% salt solution and remainder in heavy alkaline soils. At the end of this extraordinary test there was no sign of the coatings breaking down. Send for illustrated descriptive booklet giving details of this test and other interesting information.

Applying McEverlast Osaburg Wrapper. At the right, applying electrolysis proof coating.

Note absence of heating apparatus.



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Keep the Roads Open—



with one man . . .
and a Warco
Grader—

ONE MAN AND A WARCO GRADER EQUIPPED WITH A WARCO SNOW PLOW WILL DO THE JOB — EASILY . . QUICKLY . . EFFICIENTLY

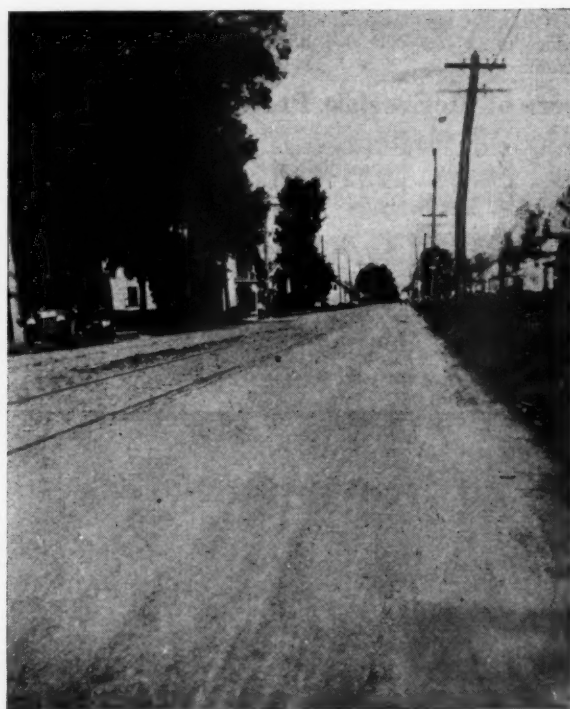
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SEE OUR EXHIBIT—A. R. B. A. CONVENTION AND ROAD SHOW, CLEVELAND, OHIO. JANUARY 14TH-18TH INCLUSIVE



The Original COLD PATCH

HEADLEY No.1

It has been successfully used for many years in the maintenance of streets and highways, in all types of wearing surfaces, such as sheet asphalt, bituminous concrete, wood block, concrete, brick and macadam.

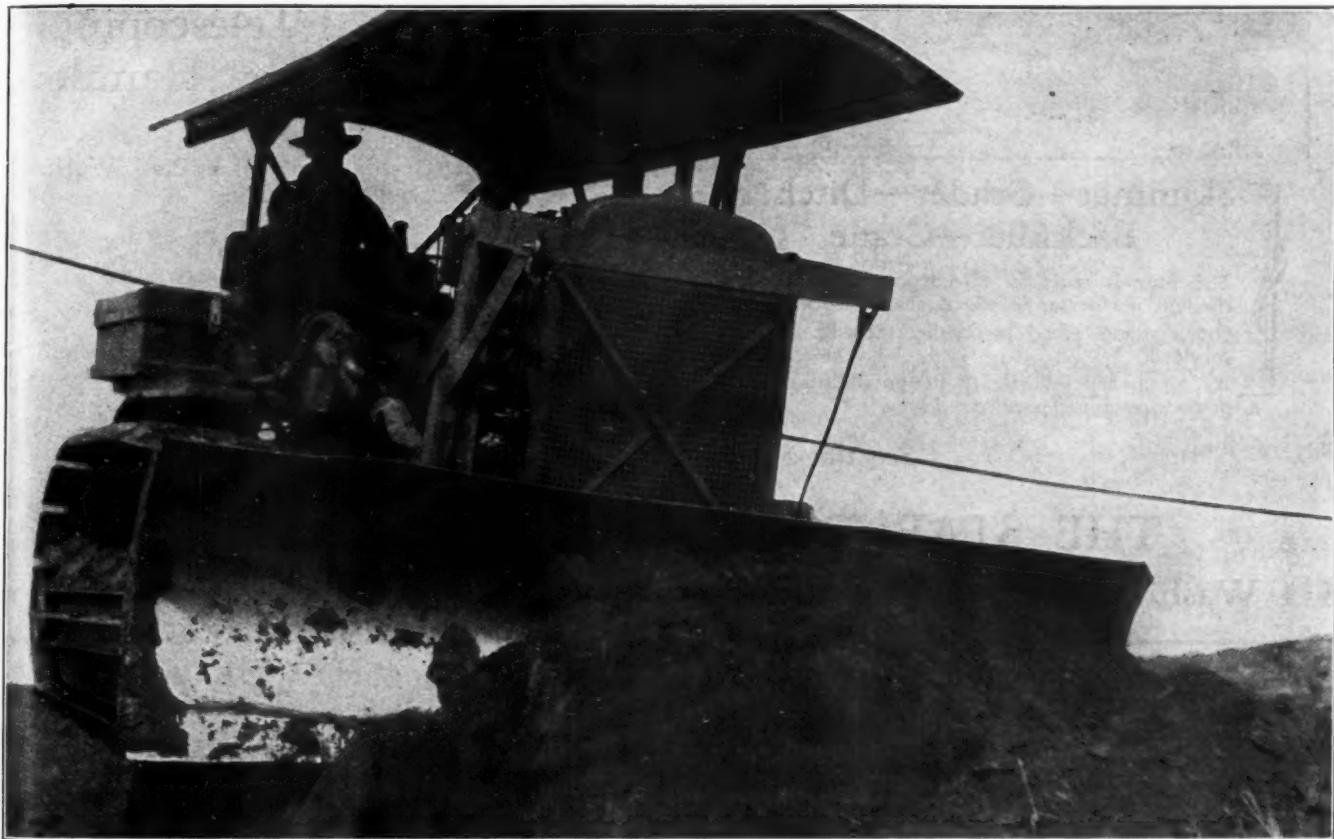
It will stay where others fail.

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descriptive booklets*

Asphalt and Road Oil

HEADLEY GOOD ROADS CO. FRANKLIN TRUST BUILDING
PHILADELPHIA, PA.

Spreading Profits



The tractor-drawn wagons have just dumped their full loads—now the bulldozer blade levels and fills—spilling the earth over the edge of the dump as fast as the wagons bring it up from the shovel. It's a "Caterpillar" job . . . "Caterpillar" track-type tractors hauling big crawler wagons . . . and "Caterpillar" tracks making it safe to bulldoze right up to the very edge!

Better, quicker, cheaper

SIXTY - \$4600
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TWENTY \$2175
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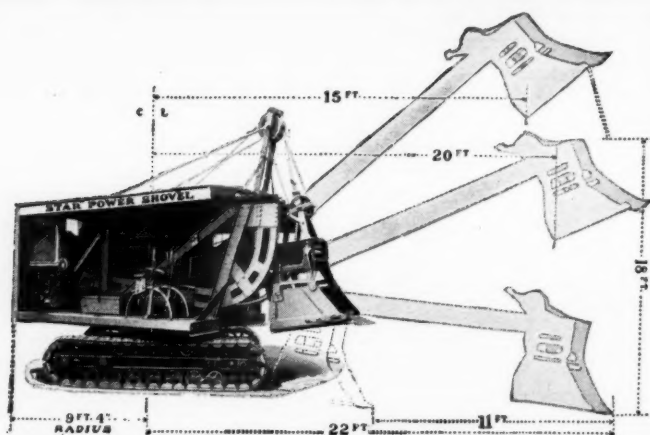
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The Star is truly an all-purpose machine—an efficient performer in all classes of work. Quick acting. Easy to handle. Sturdy. Easily serviced.

By all means investigate its possibilities as a profit earner for you.

The Star Power Shovel

One and Only Shovel Using
The Patented Telescoping
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Works in Close Quarters.

Does Shallow Grading as Well as Bank Work.

Weights 18 tons. Full Revolving.

Full Length Crawlers.

60 H. P. Waukesha Engine.

Convertible Into Sub-Digger or Crane.

Write, or send the handy coupon, for catalog and complete details.

*Some territory is still
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THE STAR DRILLING MACHINE CO.

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Put DOWFLAKE right in the Mixer

Dowflake, added right in the mix in the form of a solution, does away with the extra labor and expense of earth covering, and results in a faster-setting, more uniformly cured slab. It makes concrete more plastic, easier to spread and finish, and reduces the tendency toward surface cleavage, voids and pitting.

Dowflake has been proven practical—it saves time and money.

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

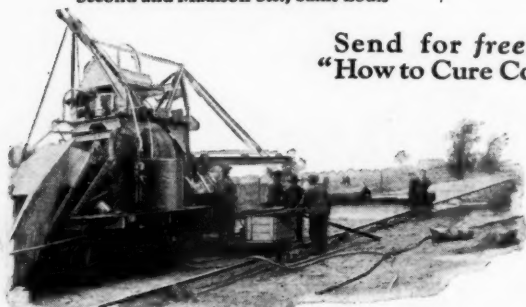
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Dowflake is packed
in handy water-
proof 100-lb. bags.

Send for free book
"How to Cure Concrete."



See the Dow display at the Road Show, Cleveland, January 14th to 18th

When you want catalogs—consult the classified INDUSTRIAL LITERATURE section, page 59



IN THE HEART OF EVERYTHING

THE HOTEL ANNAPOLIS WASHINGTON, D.C. 11th, 12th and H Sts.

The COMFORTS of a new hotel, the CON-
VENIENCE of exceptional location. Every room
has bath—every room is an outside room!!

MUCH FOR LITTLE
Single with bath.....\$3.00, \$3.50, \$4.00
Double with bath.....\$4.50, \$5.00, \$6.00

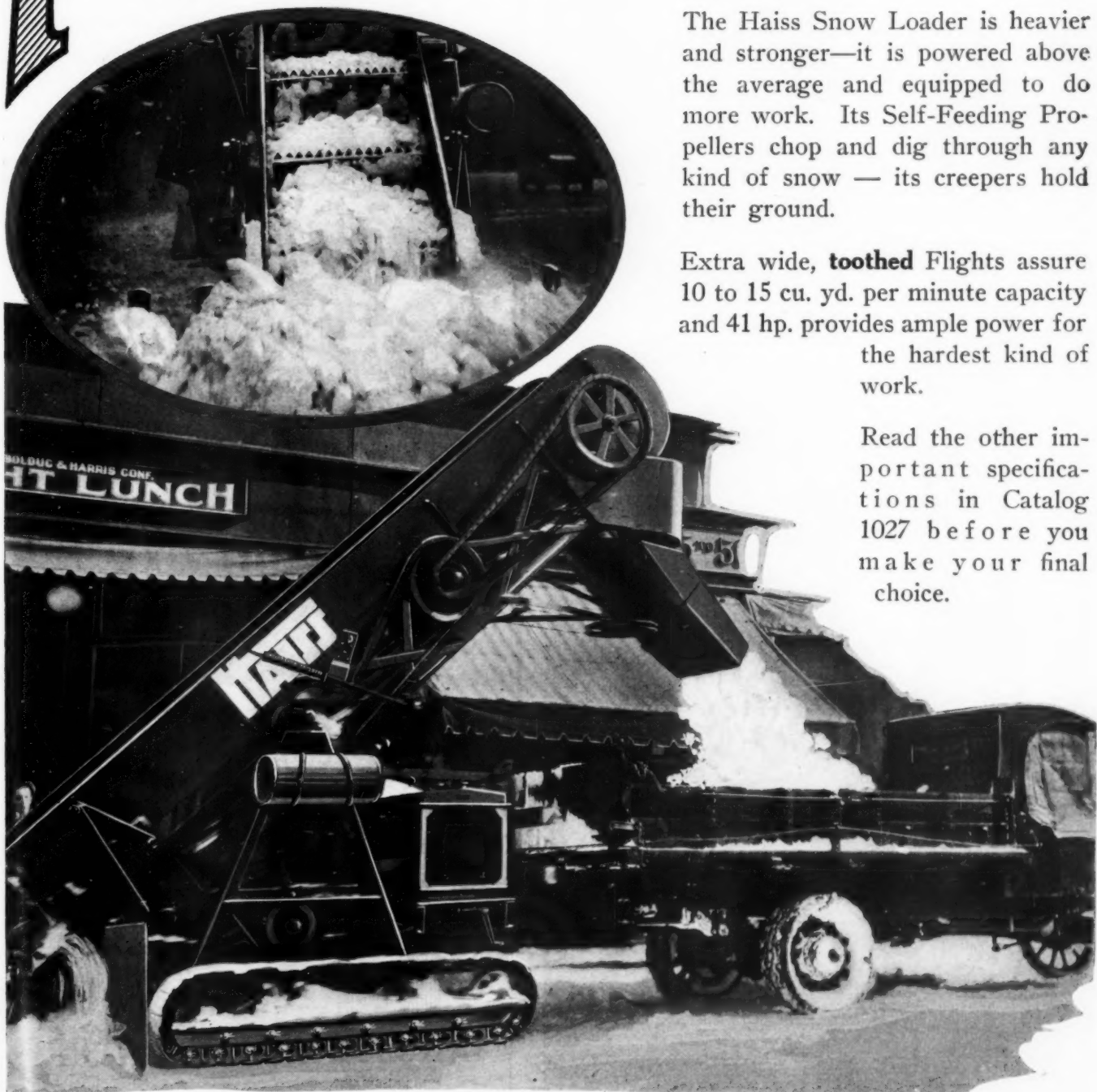
GARAGE CONNECTING—Storage \$1.00 Daily

Heavier and Stronger Digs More Snow in Less Time

The Haiss Snow Loader is heavier and stronger—it is powered above the average and equipped to do more work. Its Self-Feeding Propellers chop and dig through any kind of snow — its creepers hold their ground.

Extra wide, **toothed** Flights assure 10 to 15 cu. yd. per minute capacity and 41 hp. provides ample power for the hardest kind of work.

Read the other important specifications in Catalog 1027 before you make your final choice.



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146th Street & Rider Ave.
New York, N. Y.
Representatives in Principal Cities

Write
for
Catalog
1027

**Snow
Loaders**

Built by the makers of the well known Haiss Creeper Loaders and Portable Belt Conveyors for sand, stone, gravel, coke and coal.

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(REG. U.S. PAT. OFF.)
FIRE HYDRANTS



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Standard
for
Over 50 Years

**GATE
FOOT
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VALVES**

"Reduced"
Fittings


CAST IRON PIPE
for water
and gas

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Established 1803
PHILADELPHIA, U.S.A.

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SHEAR, FLAP, PLUG DRAIN
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BUTTERFLY VALVES
FLEXIBLE JOINTS
COLDWELL-WILCOX CO.
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SEATTLE: 1410 L. C. Smith Bldg. CHICAGO: 360 N. Michigan Avenue

**"WATCH DOG"
WATER METERS**



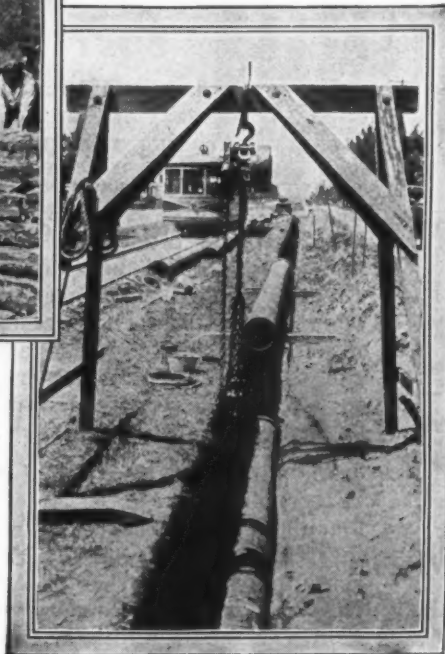
DISC, CURRENT and
COMPOUND TYPES
GAMON METER COMPANY
280-294 South Street Newark, N. J.

INDUSTRIAL LITERATURE

of materials and equip-
ment handled by our
advertisers can be eas-
ily ordered by number
from the classified list
beginning on page 61.



New method reduces pipe laying costs



-Pontiac success widely observed

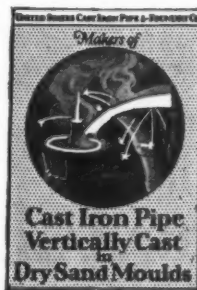
ENGINEERS and officials of leading mid-western gas companies gathered at Pontiac, Michigan, recently to inspect the laying of a new type main.

Two thousand feet of 12" multiple length* deLavaud cast iron pipe with Anthony joints was laid in record time despite unusual difficulties in grade crossings and at street intersections.

So much interest was shown in the success and economy of this latest type of cast iron pipe for high-pressure gas and water lines that a brief engineer's report of the work has been prepared. A limited number of copies of this report is available to anyone interested in this most recent development in underground pipe lines.

Photographs and data by courtesy of Consumers Power Co.

Upper left picture shows the simplicity of connecting the Anthony Joint. No special tools or skill required. Center photograph illustrates the ease of handling 24 ft. lengths of deLavaud pipe. Right hand illustration shows the chain hoist used to lower pipe into trench.



*Note: Multiple length deLavaud pipe comes in 24 ft. lengths consisting of two standard 12 ft. lengths bronze welded at the plant under ideal conditions, and shop-tested.

United States Cast Iron Pipe and Foundry Company

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Accessibility Unequaled!

If you can handle a wrench you can open any Niagara or American Water Meter for cleaning or inspection.

A wrench is necessary only to loosen the flange bolts. When the casing is lifted off the internal gears may be lifted from their bearings, the disc chamber taken from its seat and opened, the strainer slipped out or the register tried by turning the gear inside the top casing. There are no parts to stick and require hammering or prying to separate them.

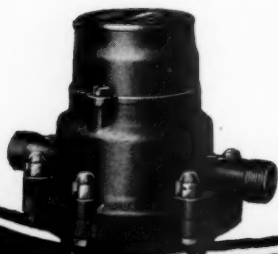
All parts of Niagara and American Water Meters are so carefully machined that they are completely interchangeable. This, with the accessibility, means that the least experienced men in your water department can repair, adjust and reassemble a Buffalo built meter reducing the cost of operating your repair department.

Get all the facts on Niagara and American Meters by sending for our new 34 page catalog which we are glad to send without cost or obligation to you.

BUFFALO METER COMPANY

2918 Main St., Buffalo, N. Y.

NIAGARA and AMERICAN
IRON CASE BRONZE CASE
N Water Meters N



for
**Water Sterilization
and Sewage Disposal**



Liquid Chlorine

A valuable illustrated booklet,
"Liquid Chlorine in Sanitation"
will be sent free upon request.

*Your water and sewage
deserve the best treatment.*

Electro Bleaching Gas Co.

PIONEER MANUFACTURERS OF LIQUID CHLORINE

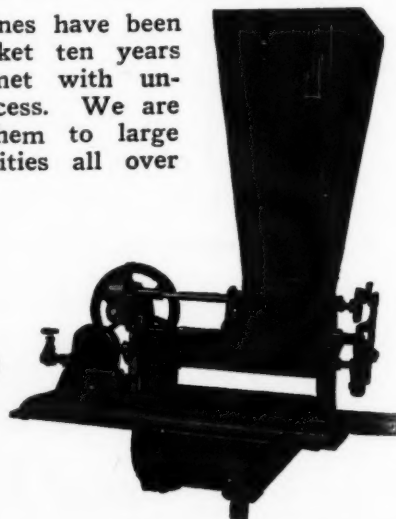
Plant: NIAGARA FALLS, N.Y.

Main office 9 East 41st Street New York.

The GAUNTT Dry Chemical Feeder

designed for feeding any dry material, especially Hydrated Lime and Sulphate of Alumina for water purification.

These machines have been on the market ten years and have met with unqualified success. We are furnishing them to large and small cities all over the country.



Write for
Catalog No. 25
giving full
description

W. J. SAVAGE COMPANY, Inc.
Knoxville, Tenn.

1929 Road Show Number

IN January, PUBLIC WORKS will issue the best Road Show Number it has ever published. Many special articles have been obtained to show the progress during the past year in the design, construction and maintenance of highways.

The authors secured are the best, the articles are exclusive and the subjects are immensely interesting. Among the leading contributors will be the following:

A. J. BRUCE

Senior Highway Engineer
U. S. Bureau of Public Roads

C. N. CONNER

Engineer Executive
American Road Builders' Assn.

W. R. NEEL

State Highway Engineer of
Georgia

J. F. COLEMAN

Maintenance Engineer
Georgia Highway Department

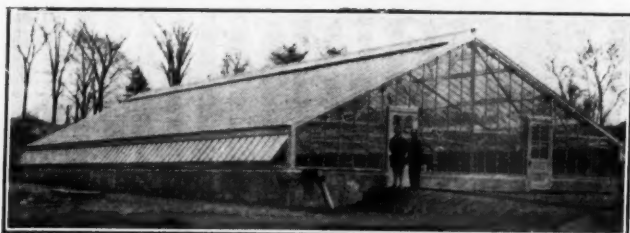
H. J. KIRK

Division of Highways and Public Improvements
State of Ohio

PUBLIC WORKS

243 WEST 39th ST., NEW YORK, N. Y.

GLASS-STEEL SLUDGE BED ENCLOSURES



BARNES ENGINEERING COMPANY, INC.

Engineers & Builders

155 East 42nd Street

New York City

For Engineering Data and Description send this Ad attached to letterhead.

A Modern Development Superseding the Greenhouse Type for Drying of Sewage Sludge

GLASS-STEEL Construction

Heavy weight: designed for 30 lbs. wind and snow loading.

Structural steel frame as in industrial building construction.

ROLLED STEEL glazing bars and sash—HOT GALVANIZED.

Acid-resisting aluminum paint.

Built to withstand extremes of temperature, alternate excessively moist and dry conditions, corrosive gases.

Common Greenhouse Construction

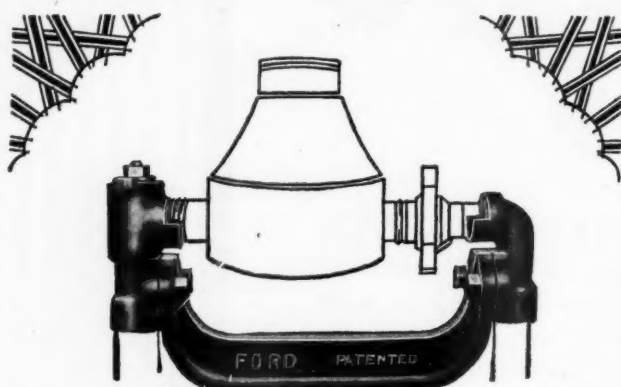
Light weight: designed for only 10 lbs. wind and snow loading.

Light flat bar frame with many tie rods.

Painted wood glazing bars and sash.

White lead paint requiring frequent renewal.

Built for very mild service of plant growing.



Ford Valve Type Yoke for Water Meter Settings

SAVES cost of regular valve and valve box, meter couplings and pipe joints because it includes an inverted ground key curb stop.

PROVIDES a more convenient valve—and meter may be quickly removed or replaced without wrench, even through a small meter box top.

Write for catalog!

The FORD METER BOX Co.
Wabash, Indiana
WATER METER SETTING AND
TESTING EQUIPMENT

Coleman's

Perfect Lead Joint Runners

Malleable

Iron

Clamp

Pouring Funnel
Greatly Increases
the Efficiency
of this Clamp



Equipped with DOUBLE WEAR Asbestos Rope
For All Sizes of Pipe

Has no Equal

Can Be Purchased Through Any Supply House
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ALLAN J. COLEMAN

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KENNEDY

VALVES~PIPE FITTINGS~FIRE HYDRANTS



Gate, Globe, Angle and Check Valves furnished for a wide range of sizes and pressures, and arranged for manual, gear, cylinder, or electric operation. Water Gates and Fire Hydrants built to American Water Works Association specifications. Underwriters' approved Gate Valves and Post Indicators.

THE KENNEDY VALVE MANUFACTURING COMPANY, Elmira, N. Y.

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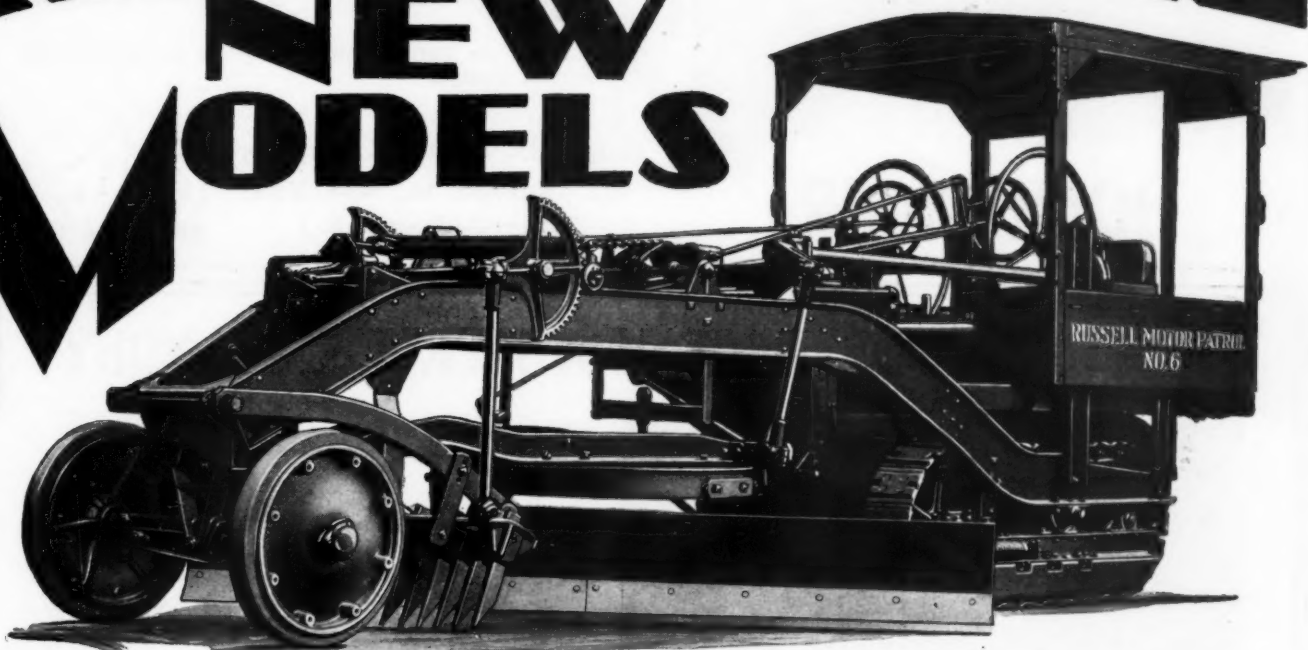


Seattle

When you want catalogs—consult the classified INDUSTRIAL LITERATURE section, page 59

RUSSELL

NEW MODELS



See The **No. 6 MOTOR PATROL**
'Caterpillar' 20 Tractor for Power
 with the **RUSSELL Display**
 at the **1929 ROAD SHOW**



Russell progress has always been along proven lines—improvements of unquestioned value—the building of better, stronger, more powerful road equipment.

Russell effort, energy and foresight have continually met the expectations and demands for greater capacity and more exacting efficiency in the tremendous job of road building and road maintenance.

Your opportunity to visualize the remarkable Russell progress is open to you at this National Exhibit—Booth No. 46 in the West wing.

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14th to
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RUSSELL GRADER MANUFACTURING COMPANY
MINNEAPOLIS, MINNESOTA



HUMDINGER

INSURE against construction delays with HUMDINGER Ball Valve Diaphragm Pumps, which have proved their superiority in the construction field.

Non-clogging, everlasting rubber ball valves, totally enclosed running-in-oil driving transmission, removable bronze bushings at all bearings, and all steel trucks—all these features are vitally necessary for economic and efficient operation.

Write today for Bulletin 1034 P. W. on HUMDINGER Contractors Pumps.

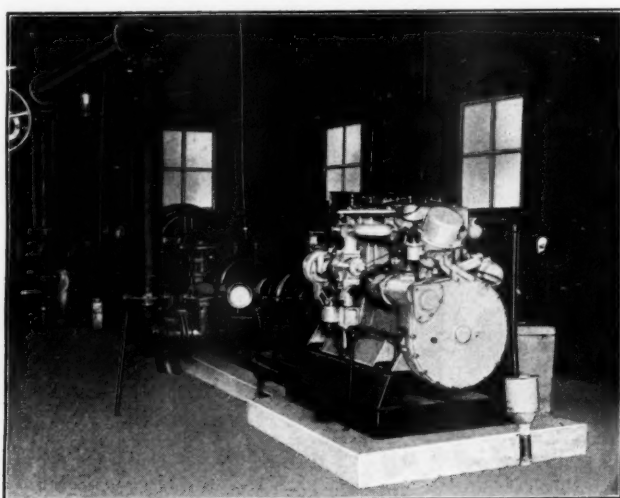
Ralph B. Carter Company

126 Chambers St., New York

Factory: Hackensack, N. J.



WHAT CAN YOU EXPECT OF A STERLING STANDBY?



Tecumseh, Ont. has a 4" 3 stage DeLaval, 720 G. P. M. 237 ft. head pump driven by 4 cylinder 100 H. P. Sterling engine, 1400 revolutions.

"Since installation it has run 11 months of 24 hours per day in 2 years without any trouble whatsoever. During June, July, August, September and October this machine has run 18 hours per day."

10 to 3,000 H.P., for standby and peak load. 900, 1,200, 14,000 R.P.M.

STERLING ENGINE CO., Dept. C-5, BUFFALO, N. Y., U. S. A.



**Sterling
High Duty
Gas and
Gasoline
Engines**

Organized 1914

Incorporated 1924

Phoenix Meter Co. Disc Water Meters

Ernest Gamon
Engineer

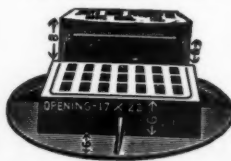
Prince's Bay,
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South Bend Foundry Co.

SOUTH BEND, INDIANA

Adjustable Curb Inlet

All Kinds of



**Gray Iron Castings
Patent Chilled
Manhole Covers**

WRITE FOR CATALOG
AND PRICES

Made in 250, 300, 350 and 400,
470, 490 lbs. Weights

To understand more fully the problems of the Mississippi



*Area Inundated by
Floods of 1927*

Major W. A. Hardenbergh, a member of the editorial staff of PUBLIC WORKS, left early in November for an extended inspection tour of the Mississippi River flood control works. Arrangements have been made with the chief of engineers and the Mississippi River Commission so that every facility will be granted him to view the work.

The result will be a series of articles describing fully the scope and plans of the work, and these will be followed later by special articles, written by men actually engaged on the work.

Adequate control of the Mississippi River is of vital importance to the prosperity and welfare of the nation, and more than \$300,000,000.00 will be spent on flood control works during the next ten years. This gigantic public improvement is an engineering and construction problem of tremendous magnitude, which is of unusual importance to engineers, contractors and manufacturers of construction equipment.

The method PUBLIC WORKS has chosen to cover the highly important work of flood control is in line with its policy of thoroughness and is in keeping with its high editorial standards. The editors have always endeavored to present the best and most practical articles obtainable and have spared no effort to obtain them.

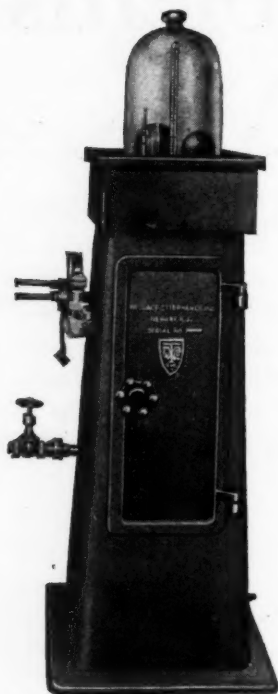
PUBLIC WORKS

243 W. 39th Street

New York City



SHIELDING CHICAGO'S HEALTH



*W & T Vacuum Chlorinator type MSV
Available for either manual or
automatic operation.*



*Chlorination Booth, 68th Street Pumping
Station, Chicago, Ill.*

64 W & T Vacuum Solution Feed Chlorinators

sterilize every drop of the ONE BILLION GALLONS of drinking water delivered to the City of Chicago every day!

After searching investigations and exhaustive tests the engineers of the City have adopted W & T Vacuum Solution Feed Chlorinators as the standard equipment for the City. That is because of their sturdy construction, longer life, ease of handling, and visibility of control—possible only because of the vacuum feature exclusive with W & T Solution Feed Chlorinators.

Chicago is an outstanding example of the successful use of Chlorination to protect the public health. All installations are *solution feed*—all installations are in duplicate. Constant attendance is provided—tests for available Chlorine are made every hour.

As a result the typhoid fever death rate in Chicago is the lowest for any large City in North America—0.7 per hundred thousand. Before the advent of Chlorination it was 15.8 per hundred thousand!

"The only safe water is a sterilized water"



WALLACE & TIERNAN

COMPANY, INCORPORATED

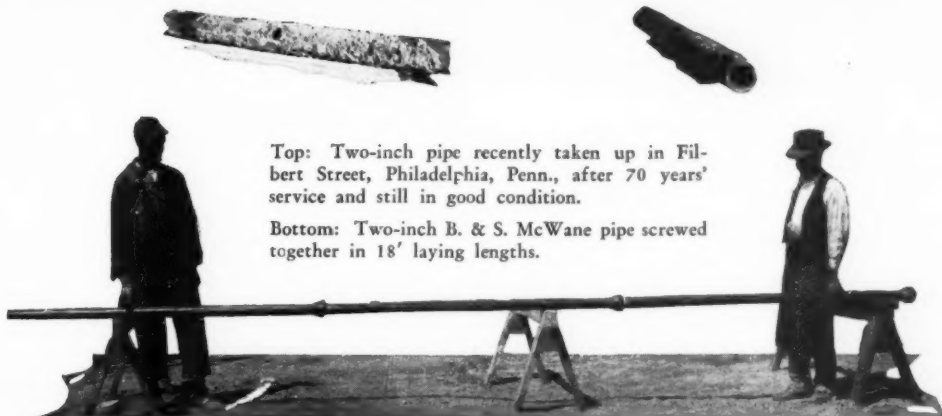
Manufacturers of Chlorine Control Apparatus

NEWARK NEW JERSEY



NEW YORK	CHICAGO	KNOXVILLE	SAN FRANCISCO	MINNEAPOLIS	PITTSBURGH	DALLAS	KANSAS CITY
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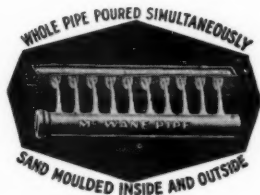
SA 16



Top: Two-inch pipe recently taken up in Filbert Street, Philadelphia, Penn., after 70 years' service and still in good condition.

Bottom: Two-inch B. & S. McWane pipe screwed together in 18' laying lengths.

Why You Should Say "McWane" When You Buy Small Pipe



McWane small diameter pipe is furnished with or without Precalced joints . . . lengths of 6', 12' or 18' . . . is easily, simply and swiftly laid . . . can be tapped direct under pressure, without fittings.

McWANE is the largest manufacturer of small diameter cast iron pipe in the world . . . the only maker of 1 1/4" pipe. McWane leadership in this field is not an accident. Years of research and specialization are back of it.

Small diameter cast iron pipe has been made for a century . . . witness the photographs above of Philadelphia pipe 70 years old and as good as new. But McWane pioneered the manufacture of this product on a commercial scale in the last decade.

It is consistent to use cast iron for service lines the same as for your mains . . . then your entire pipe system is permanent construction. The *cost per year* of cast iron service lines is far less than any substitute.

WRITE FOR ILLUSTRATED LITERATURE

McWANE CAST IRON PIPE CO.
BIRMINGHAM, ALA.

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SALES OFFICES IN PRINCIPAL CITIES

McWANE

CAST IRON PIPE

Plowing Through!

POWER to plow through heavy snow-drifts—speed to clear the lighter falls—thus Trackson McCormick-Deerings keep the highways open all winter. They are a sure guarantee for Open Roads.

Dependable under all weather and ground conditions, these Master Crawler-Tractors bring rugged, sure-footed power to any job. Real operating economy is assured by their faithful, efficient performance.

With the passing of the last snow fall, Tracksons are ready for road building, maintenance and construction work. For year 'round service, highway officials find them indispensable.

Learn how you may solve your snow problems. Write now for full particulars.

Trackson Company
FULL-CRAWLERS & TRACTOR EQUIPMENT
503 CLINTON ST. MILWAUKEE, WIS.



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NEEDED seldom Available always and everywhere Skilled, prompt and at low cost

That is the truck owner's estimate of what Repair Service should be That is the Repair Service that owners of Graham Brothers Trucks depend upon, *and know they can depend upon*, everywhere.

These fast, powerful, sturdy trucks—in sizes to fit 96% of all hauling needs—are built by Dodge Brothers to make money for their owners year after year, mile after mile. This

objective guides every manufacturing step—from design and selection of materials to final inspection.

Then, after the truck is at work, the world-wide Dodge Brothers Dealer organization stands ever ready to *keep it at work*.

The never-failing ability of Graham Brothers Trucks to work well, work at low cost and keep on working, accounts for the fact that, even with tremendous production, orders continue to keep ahead of the builders.

PRICES

MERCHANTS EXPRESS	\$ 665
—110' wheelbase	
COMMERCIAL TRUCK	775
—120' wheelbase	
1¼-TON—130' wheelbase	995
1¼-TON—140' wheelbase	1065
1¼-TON—150' wheelbase	1345
1¼-TON—165' wheelbase	1415
2-TON—150' wheelbase	1545
2-TON—165' wheelbase	1615
3-TON—135' wheelbase	1745
3-TON—165' wheelbase	1775
3-TON—185' wheelbase	1845

Chassis f. o. b. Detroit

GRAHAM BROTHERS TRUCKS

BUILT BY
TRUCK DIVISION OF
DODGE BROTHERS

SOLD AND SERVICED BY
DODGE BROTHERS
DEALERS EVERYWHERE

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Itemized Costs of Construction

Sewage Treatment Plant and Relief Trunk Sewer

Borough of Red Bank, Monmouth County, New Jersey

Type of Plant: Separate Sludge Digestion

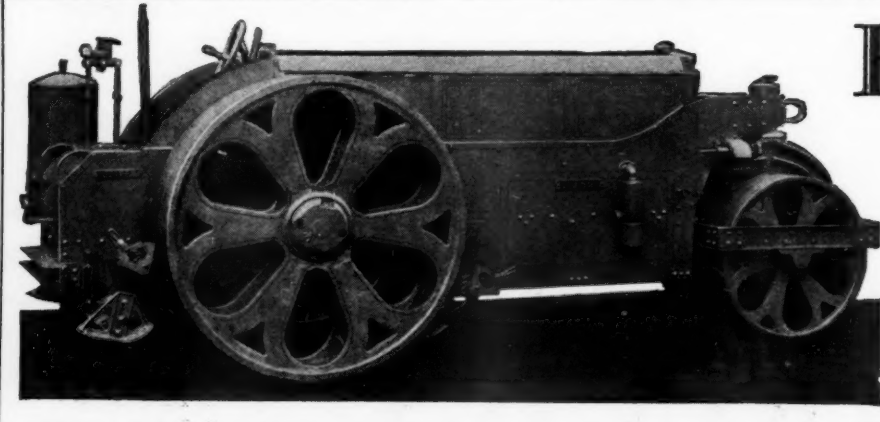
H. Burdett Cleveland, Consulting Sanitary Engineer, 225 Broadway, New York

Bids Received September 17, 1928

(1) H. L. Harrison & Son, Inc., Newark, N. J.; (2) Suburban Engineering Co., N. Y.; (3) Watchung Construction Co., Inc., Plainfield, N. J.; (4) Mahlon Averill, South Orange, N. J.; (5) W. L. Lowell, Inc., Mullica Hill, N. J.; (6) Forbes-Murphy Constr. Co., Baltimore, Md.; (7) S. S. Thompson & Co., Red Bank, N. J.; (8) Tuller Constr. Co., Red Bank, N. J.; (9) Coast Constr. Co., Red Bank, N. J.; (10) J. L. Sigretto & Sons, Inc., N. Y.; (11) Kuchar Bros., Montvale, N. J.; (12) Angelo Fastiggi, Allenhurst, N. J.

Awarded contracts.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Description of Items									
18% Misc. Small Exc., 12% grading.....	\$1.50	\$3.40	\$4.00	\$4.00	\$3.00	\$4.83	\$5.50	\$4.00	\$6.00
5 cu. yds. Rock Excavation.....	5.00	10.00	10.00	10.00	.01	8.00	5.00	6.00	5.00
6,610 cu yds. Excess Fill taken from river, silt cover to be removed first, includes grading and seeding and rolling beneath pipe lines.....	1.25	0.90	1.20	1.00	1.50	1.25	0.50	1.00	0.40
2,960 lin. ft. Piling 12" Butts, over 30' long.....	0.80	0.80	0.90	1.10	1.10	1.00	1.00	0.80	1.20
2,295 lin. ft. Piling 10" Butts, under 20' long.....	0.75	0.80	0.90	1.05	0.80	1.00	1.00	0.75	0.60
1,100 cu. yds. 1:2:4 Reinforced Concrete (exclusive of sea wall and including reinforcement) 47% sides and bottoms of tanks 12'-30". 53% misc. small sections 6'-10'.....	34.00	26.00	28.00	28.80	31.60	32.10	32.00	33.00	30.00
378 lin. ft. Sea Wall. 11 high 37 sq. ft. section. 1 1/2" Gunite face (includes cofferdam, excavation, concrete, reinforcing and expansion joints, complete).....	40.00	49.00	41.50	45.75	53.00	51.80	44.00	58.00	60.00
Superstructure of Screen and Grit Chamber 6,800 cu. ft., common brick, steel trusses, red tile roof.....	2,600	2,270	3,000	3,000	2,000	2,055	2,000	2,200	3,000
Superstructure of Settling and Chlorinating Tanks 2,200 cu. ft., same as above.....	5,800	7,800	12,000	15,000	12,606	9,920	9,800	11,000	11,000
Superstructure of Digestion Tank 8,000 cu. ft., common brick ends, stucco on ribbed lath sides, red tile roof.....	3,500	2,450	3,300	2,500	2,138	2,529	2,300	3,000	4,000
26,500 lbs. Flanged Cast Iron Pipe and Fittings, Class A, in place.....	.10	.07	.065	.09	.10	.10	.12	.13	.12
2,500 lbs. B. & S. Cast Iron Pipe and Fittings, Class A, in place.....	.07	.05	.05	.07	.07	.08	.15	.10	.10
16,500 lbs. Wrought Iron and Steel Screens, Gratings and Covers.....	.12	.14	.15	.11	.12	.10	.20	.14	.12
24,000 lbs. 24,000 lbs. Structural Steel I-Beams....	.10	.08	.08	.06	.06	.05	.10	.06	.12
1.5 M. ft. B. M. Lumber in place, for pipe foundations, covers and splash boards.....	100.00	120.00	90.00	90.00	220.00	160.00	200.00	100.00	100.00
172 cu. yds. Sand Fill for Sludge Bed.....	3.00	3.70	3.00	3.50	4.00	4.25	5.00	4.00	4.00
194 cu. yds. Graded Gravel Fill for Sludge Bed....	4.00	5.00	3.50	4.00	6.00	5.40	6.00	5.00	5.00
46 cu. yds. Clay Fill, Rammed, for Sludge Bed....	5.00	5.00	6.00	3.50	4.00	3.00	5.00	3.00	4.00
Sludge Bed Cover 74'x151'.....	15,000	14,170	16,260	14,300	12,560	14,176	12,000	14,000	14,000
575 lin. ft. 20" Vitrified Tile Inlet and effluent Sewers, 2'-5' cover, partly in fill.....	3.00	5.00	2.75	2.50	8.00	3.20	3.00	6.00	3.00
179 lin. ft. 15" Vitrified Tile Inlet Sewer 2'-5' cover	1.25	3.00	2.00	3.00	1.50	2.50	4.00	4.00	3.00
370 lin. ft. 10" Vitrified Tile Sewer for connecting lines, 80% placed in fill.....	1.00	2.00	1.50	1.00	1.20	1.50	2.00	1.00	1.50
219 lin. ft. 6" Vitrified Tile Drain, cemented joints, in sludge bed.....	0.50	0.30	0.35	0.50	0.50	1.00	1.00	0.30	1.00
896 lin. ft. 4" Open Tile Underdrains in sludge bed.....	0.30	0.20	0.18	0.20	0.40	0.20	0.40	0.25	0.50
204 lin. ft. 20" Cast Iron Effluent Sewer in rock filled trench 3' wide and 1' over pipe, from low water to end.....	6.00	15.50	7.00	8.50	20.00	7.10	9.00	13.00	10.00
3 Manholes 4'-6" deep.....	85.00	100.00	85.00	95.00	60.00	100.00	100.00	125.00	90.00
55 lin. ft. 18" Vitrified Pipe in Chlorinating Chamber.....	1.75	2.5	1.35	1.50	2.00	1.70	3.00	2.00	3.00
2-18" Sluice Gates Installed.....	175.00	190.00	160.00	150.00	140.00	155.00	170.00	150.00	150.00
3-12" Sluice Gates Installed.....	100.00	90.00	72.00	80.00	140.00	100.00	115.00	100.00	100.00
2-10" Sluice Gates Installed.....	100.00	75.00	110.00	100.00	95.00	113.50	125.00	90.00	110.00
5-8" Gate Valves, Installed.....	50.00	45.00	40.00	37.00	50.00	60.00	50.00	75.00	50.00
10-6" Gate Valves, Installed.....	32.50	30.00	32.00	26.00	31.00	35.00	45.00	50.00	40.00
2-6" Three-way Gate Valves, Installed.....	125.00	140.00	125.00	125.00	50.00	130.00	170.00	70.00	75.00
2-5" Gate Valves, Installed.....	25.00	30.00	25.00	23.00	25.00	33.00	45.00	25.00	25.00
8-4" Gate Valves, Installed.....	20.00	15.00	16.00	18.00	22.00	24.00	25.00	20.00	20.00

(Continued on page 51)



HUBER

4-CYLINDER MOTOR ROLLERS

Powerful and dependable, quick in action, economical to operate. Made in 4 sizes (5-7-10-12 Tons). Send for Huber Motor Roller Catalog.

Write for Catalog

The HUBER MFG. CO.

345 E. Center St. Marion, Ohio

1 Central Pump, Open Impeller, 4" suction, 4" discharge, 225' head, 250 g.p.m., 3 H.P. motor..	900.00	800.00	1,000.00	800.00	700.00	897.00	1,100.00	700.00	900.00
1 Centrifugal Pump, Standard Impeller, 5" suction, 4" discharge, 15' head, 250 g.p.m., 3 H.P. motor	1,000	870.00	1,075.00	1,540.00	750.00	957.00	1,170.00	800.00	1,000.00
1 Centrifugal Pump, Open Impeller, 5" suction, 4" discharge, 20' head, 150 g.p.m., 3 H.P. motor.	1,000.00	880.00	1,075.00	1,540.00	750.00	957.00	1,170.00	700.00	950.00
131 lin. ft. Galvanized Pipe Railing.....	2.50	2.50	2.50	1.50	2.00	2.00	4.00	2.00	2.00
500'-2" Water Supply Line. 60% in ground and 40% is attached to concrete walls, includes 5 faucets, 3 —?	1.00	1.50	1.00	0.75	0.60	0.70	3.00	1.00	0.60
2-26" Ventilating Fans. Each with 40' of 8"x24" 20 gage galvanized ducts.....	350.00	190.00	375.00	300.00	400.00	330.00	400.00	200.00	400.00
2 Roof Ventilators, 16" necks.....	50.00	40.00	75.00	35.00	55.00	40.00	50.00	60.00	25.00
1-2 Ton Chain Hoist and Trolley exclusive of I-Beam	175.00	120.00	450.00	200.00	220.00	200.00	300.00	200.00	175.00
Removal of Present Structures. 35'x116' Settling Tanks, 45' Circular Tank and small chlorine bldg. and tanks	1,000.00	2,700.00	2,000.00	1,500.00	900.00	800.00	2,500.00	500.00	2,200.00
Sludge Heating Apparatus. 5 section gas boiler with safety flame trap, pressure trap and other appurtenances and 600 ft. of 2" galv. pipe radiation	1,000.00	1,180.00	1,500.00	1,300.00	878.00	1,400.00	3,000.00	1,500.00	800.00
2 Sludge Collection Apparatus for 35 sq. tanks. 17'4" deep as m'd by the Dorr Co.	6,850.00	7,700.00	7,100.00	7,300.00	6,315.00	6,700.00	6,950.00	6,950.00	6,500.00
or ditto as m'd by Link-Belt Co (tanks 17'6"-70')	3,500.00	3,500.00	3,000.00	3,000.00	2,400.00	2,700.00	3,180.00	3,000.00	2,700.00
or ditto as m'd by Harding Co.	3,785.00	4,400.00	3,650.00	3,000.00	3,500.00	3,600.00	3,850.00	4,100.00	3,850.00
1 Sludge Collecting and Stirring Apparatus. For Digesting Tank 45' in diameter and 20' deep as m'd by the Dorr Co.	6,055.00	6,800.00	6,293.00	6,400.00	6,000.00	6,050.00	6,280.00	6,200.00	6,000.00
or ditto as m'd by Hardinge Co.	6,300.00	7,140.00	6,625.00	6,400.00	6,000.00	5,950.00	6,430.00	6,200.00	6,600.00
Summation of Unit Price Bids. With no alternative included and with lowest priced mechanism bid, only, included.....	\$130,651	\$123,446	\$140,221	\$141,754	\$143,612	\$144,818	\$147,184	\$147,704	\$149,106
Alternate for Superstructure of Screen and Grit Chamber with Mechanical Screen 4,600 cu. ft., brick walls, steel trusses, red tile roof.....	3,100	1,800	3,500	3,000	2000	900	1,500	2,100	2,550
Alternate for 3' Mechanically Cleaned Screen as m'd by the Dorr Co.	1,625	1,875	1,825	1,800	1,600	1,958	1,800	1,500	1,850
Time of Completion—Working Days.....	250	215	200	250	240	175	200	180	200
Relief Trunk Sewer. 100% dry construction; 62.5% to 87.5% machine; route 5.5% paved..	(1)*	(3)	(7)	(10)	(9)	(8)	(11)	(4)	(12)
460 lin. ft. 20" Sewer, 0-8' depth.....	3.00	2.90	2.00	5.20	4.80	4.75	4.00	4.00	5.00
240 lin. ft. 20" Sewer, 8'-10' depth.....	3.25	3.80	4.30	5.70	5.40	5.55	5.50	5.70	6.00
626 lin. ft. 20" Sewer, 10'-12' depth.....	3.60	5.20	4.90	6.70	6.80	6.90	7.00	8.10	8.00
800 lin. ft. 20" Sewer, 12'-15' depth.....	4.25	6.75	5.70	8.60	7.75	8.10	10.00	9.10	10.00
160 lin. ft. 15" Sewer, 8'-10' depth.....	2.50	2.00	3.90	4.00	4.80	5.00	5.00	5.25	5.00
138 lin. ft. 15" Sewers, 10'-12' depth.....	3.00	3.00	4.60	5.00	6.50	7.00	6.50	7.00	7.00
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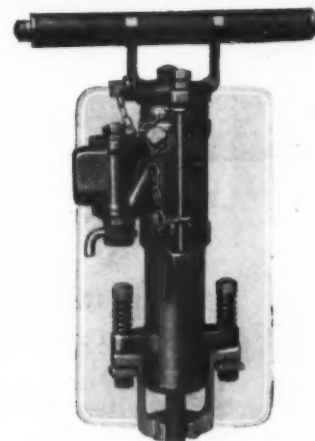
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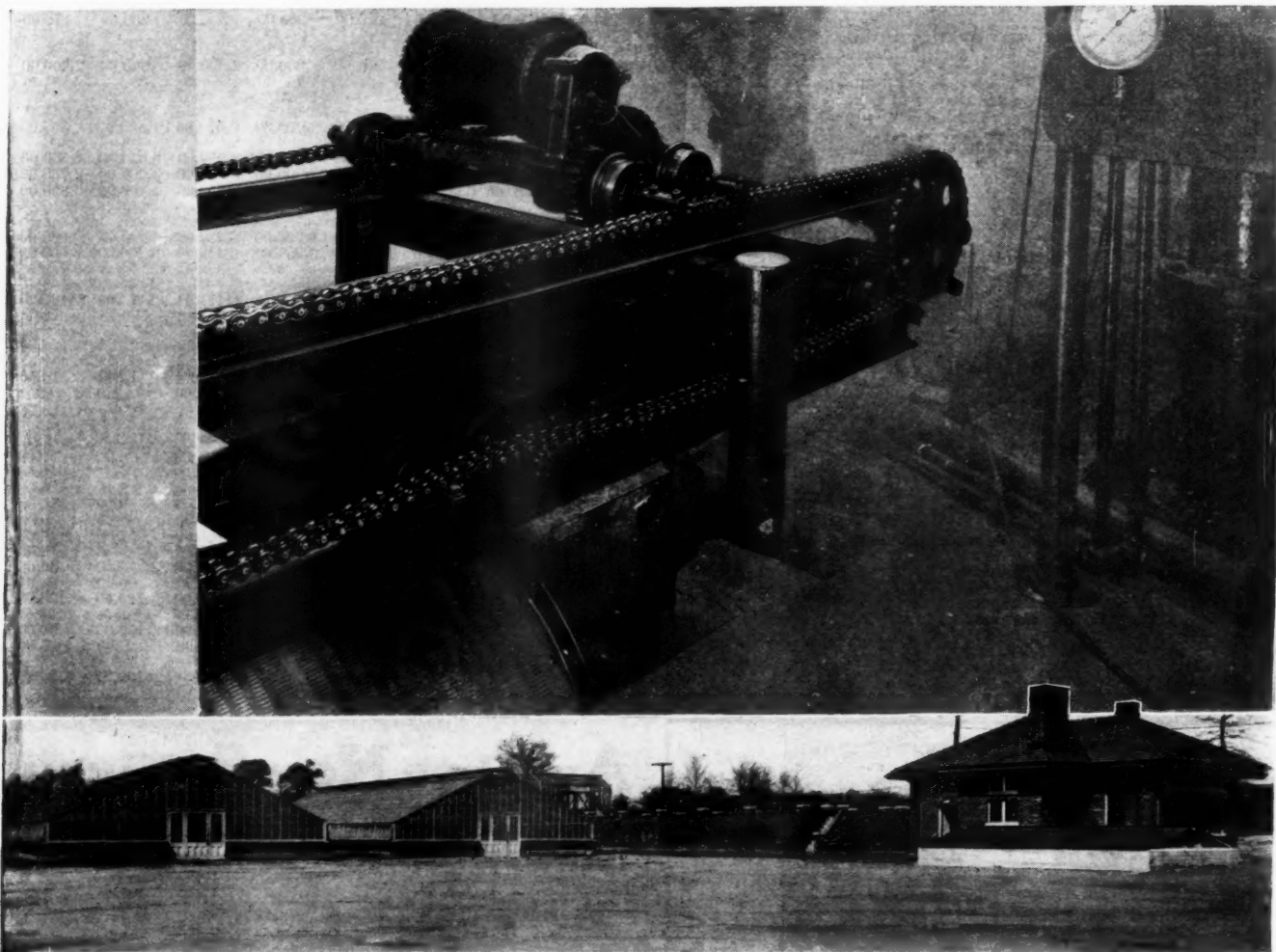
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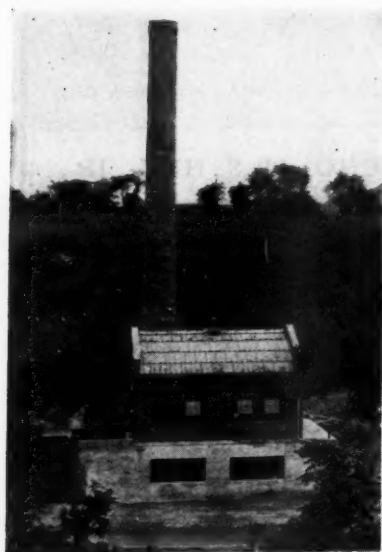
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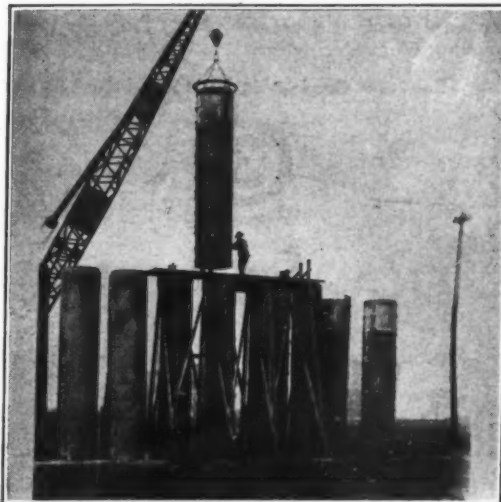
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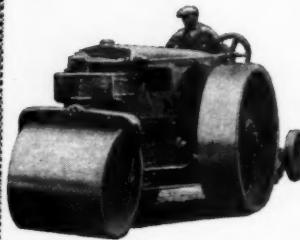


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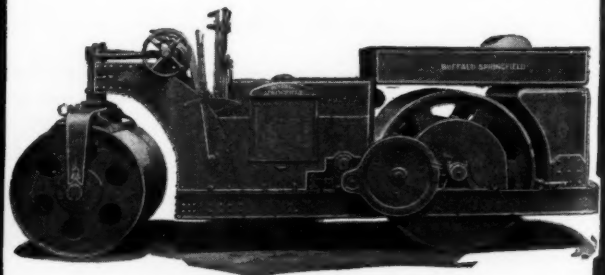
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5. Methods of constructing Sheet Asphalt, Asphaltic Concrete, and Asphalt Macadam pavement are simply described in illustrated booklets issued by The Texas Company, 17 Battery Place, New York City.

6. Natural Rock Asphalt for Street, Highways, Bridges, Sidewalks, Patching, Resurfacing, etc. Describes the product and its uses. Illustrated. Published by the Natural Rock Asphalt Corporation, Louisville, Ky.

Asphalt Plants

10. J. D. Farasey Mfg. Company, Cleveland, Ohio, issue folders of specifications for Farasey Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours.

Backfillers

15. Buckeye Backfiller-Cranes are attractively illustrated and described in the new 16-page, two-color bulletin just issued by The Buckeye Traction Ditcher Company, Findlay, Ohio. It is full of operating views and data, and construction details.

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17. Ingersoll-Rand Paving Breakers which are made in two sizes, are designed for tearing up pavements and hard surfaces and are also used on all kinds of demolition. Bulletin 4164.

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21. Buckets for every purpose are described in detail and clearly illustrated in catalogue 425 issued by The George Haiss Mfg. Co., 141st St. & Rider Ave., New York, N. Y.

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25. A folder describing Reliance Chip Spreader, a special trailer with dump body and hoist. Spreads any thickness desired. Does better work than can be done by hand and cuts cost. Universal Road Machinery Co., Kingston, N. Y.

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30. "How to Cure Concrete," a forty-seven-page manual published by the Dow Chemical Company, Midland, Michigan, treats fully the subject suggested by its title. A well-illustrated and instructive volume.

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33. Curing Concrete Without Dirt and Water by the Hunt Process. Illustrated description of curing method that makes concrete 8½ per cent stronger. Everlasting Paint and Sales Co., 1110 Board of Trade Bldg., Los Angeles, Calif.

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41. Koehring Company, Milwaukee, Wisconsin. Catalog showing complete line of paving mixers manufactured in sizes of 7E, 13E and 27E.

42. Koehring Company, Milwaukee, Wisconsin. Illustrated 48-page catalog on construction mixers giving complete specifications of 10S, 14S, 21S and 28S sizes.

43. Koehring Company, Milwaukee, Wisconsin. Have new illustrated folder on the 5S Dandie; also descriptive card on 10S Dandie.

44. Concrete Mixers manufactured by the Jaeger Machine Company, Columbus, O., described in booklet. 32 pages, 6x9.

Chutes and Towers, Concrete

45. The Insley Manufacturing Company, of Indianapolis, describes concrete chutes in connection with steel towers and Mast Hoist Plants in Catalogs 44 and 45. 95 pages and 16 pages, 8x11.

Cranes, Backfiller

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Crushers

57. Descriptive, up-to-date bulletins on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg. Co., Galion, O.

Dredges

60. The Bay City Dredge Works, Bay City, Mich., issue Catalog D, describing Bay City Land Dredges for canal and open ditch excavation or cleanout and ditch maintenance work. Oil engine operated. 72 pages, 6½x10.

Drills

63. Sullivan Machinery Company, Chicago, has a new catalog, No. 81-E, describing its DW-64 water jet tunnelling drill. 135 lb. weight. May be used on tripod or bar for down holes to 32 ft., or as 90 lb. hand drill with suitable handles. 16 pages, 6x9.

66. "Jackhammer" Drills are built in six sizes. The 27-lb. BAR-33, is recommended for soft rock, concrete, etc.; the 75½-lb. DDR is recommended for the heaviest and roughest work. Intermediate sizes meet other drilling conditions the world over. Bulletin 4146. Ingersoll-Rand Co., 11 Broadway, N. Y.

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71. "Dump, Bodies, Steel." WOOD Hydraulic Hoist & Body Co., Detroit, Mich., manufacturers all Steel Dump Bodies for every hauling proposition and Self-Dumper Bodies for road builders Trucks. Special Bulletins.

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80. "Novo Hoisting Handbook." Gives detailed descriptions of hoisting jobs of every type in every part of the country. Completely illustrated with pictures and diagrams. Novo Engine Co., Lansing, Michigan.

Hoists, Dump Truck

85. "Hoist, Dump Truck." Double the Truck's Value by using power operated Hydraulic Hoists. Catalog of WOOD Hydraulic Hoist and Body Company, Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Hoppers, Measuring

90. The C. S. Johnson Co., Champaign, Ill., publish a folder which describes the Johnson Demountable Bins and Measuring Hoppers. Sent on request.

Loaders and Unloaders

94. Catalog 328 treats the "Haiss 16" exclusively. It contains specifications, illustrations and construction details of this loader for stockpiles. Geo. Haiss Mfg. Co., 141st St. & Rider Ave., New York, N. Y.

95. The Chicago Automatic Conveyor Co., 1845 So. 55 Ave., Cicero, Ill., issue literature describing Portable Conveyors with Non-Clogging Receiving ends. Sent on request.

96. The Universal Road Machinery Company, Kingston, N. Y., issues two bulletins describing the Reliance Portable Car Unloader and Reliance Chip and Sand Spreader.

97. Link-Belt Company, Philadelphia, the originators of Portable Loaders, have issued a folder on the famous "CUB" Loader (belt type), and the Type "C" bucket loader, with condensed information on other popular types.

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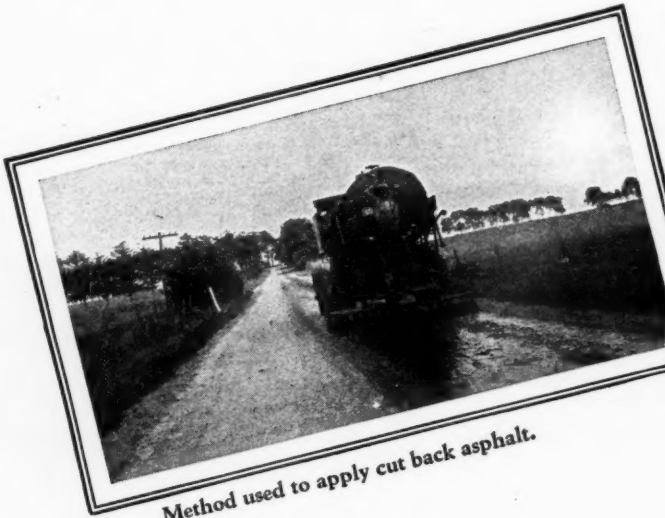
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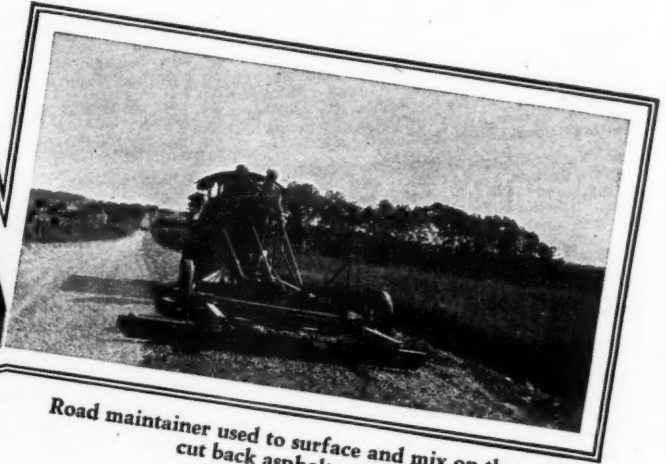
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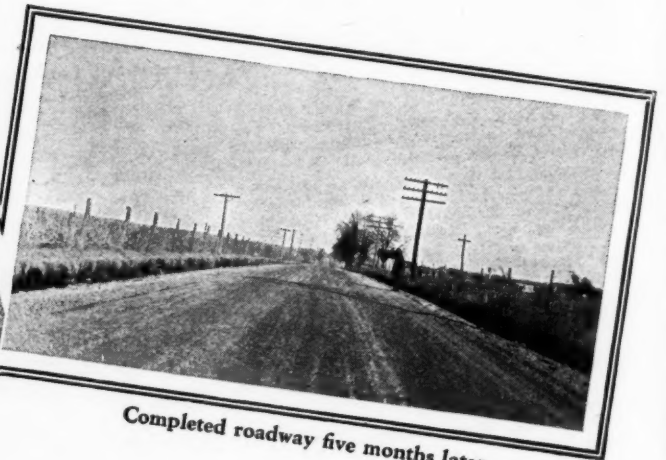
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99. Car Loaders. The Heltzel Bulletin No. 8 describes car unloaders and other contractors' equipment. The Heltzel Steel Form & Iron Co., Warren, Ohio.

102. Haiss Creeper Model, path digging loaders are well illustrated and detailed specifications are given in catalogue 527. Also interesting copyrighted table for figuring haulage per day. Geo. Haiss Mfg. Co., 141st St. and Rider Ave., New York, N. Y.

103. The application and need of portable conveyors with many illustrations showing how Haiss meets these needs is handled in catalogue 1127. Geo. Haiss Mfg. Co., Inc., 141st St. and Rider Ave., New York, N. Y.

104. Construction details of Haiss Materials Handling Equipment and descriptions of miscellaneous accessories are given in catalogue 623. George Haiss Mfg. Co., 141st St. and Rider Ave., New York, N. Y.

105. A new Trackson circular gives a complete description and pictures of the Trackson high-lift loader, low-lift shovel, and industrial crane, which are designed for mounting on the McCormick-Deering 10-20 Industrial Tractor, with either wheels or crawlers. This information will be sent on application to the Trackson Company, 503 Clinton St., Milwaukee, Wis.

Motor Trucks

107. "Trucks for Federal, State, County and City Governments," issued by Graham Brothers, the truck division of Dodge Brothers, Inc., gives information about company's trucks in municipal, county, state and government activity.

Mixing Plants, Central

110. Blaw-Knox Company, Pittsburgh, Pa., has prepared fully illustrated Bulletins on Central Mixing Inundation Plants; Steel Bins; equipment to measure aggregate by volume and weight and other important data for contractors.

Paving Materials

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. Profusely illustrated with photographs. 24 pages, 6x9. The Barrett Company, 40 Rector Street, New York.

112. All about Warrentite Bitulithic pavement for all road conditions described in 15 booklets of words and pictures. Scenic views and technical descriptions of famous highways. Warren Bros. Company, Boston, Mass.

Pneumatic Tools

114. Ingersoll-Rand Pneumatic Tools—chipping, scaling, and calking hammers; clay diggers and picks; riveters, holders-on and jam riveters; drills, including track, close quarter and wood-boring types, portable saws; compressed air motors and motor hoists; sand and backfill rammers. A tool for every requirement. Catalog 8000.

Poles, Concrete

115. Machine made concrete poles for distribution or transmission lines, trolley supports, signs, lighting standards, etc., with expensive equipment, are described in Bulletin of Asphalt-Concrete Corporation, 1440 Broadway, N. Y.

Pumps, Contractors'

120. The Edson Manufacturing Corporation, Boston, describes its improved designs in diaphragm pumps, both hand and power; odorless force pumps, and suction hose for the same and other pump accessories. 9 pages, 8½x11.

121. Bulletin No. 56, illustrating the Barton Portable Pump and its attachment to automobile motors, describing the simplicity of operation and its many practical uses, issued by the American Steam Pump Co., Battle Creek, Mich.

122. Humdinger Diaphragm force pumps open discharge diaphragm pumps, triplex road pumps and portable centrifugal pumps described and illustrated in bulletin No. 102. Ralph B. Carter Co., 152 Chambers Street, New York City.

Road Finishing Machines

125. The Heltzel Steel Form & Iron Co., Warren, Ohio, publish a treatise of finishers, strikeoffs and graders, including descriptions of hand finishers, automatic strikeoff and grader.

Road Rollers, Scrapers, Graders, etc.

130. Everything for the Road Maker. Good roads Machinery Co., Kennett Square, Pa., issue a 48-page catalogue describing complete line of Road Graders, Rock Crushers, Road Drags, Road Rollers, Oiling Machinery and Culvert Pipe.

131. The Buffalo Springfield Roller Company, Springfield, Ohio. Pocket size booklet with return card, showing all types of Buffalo Springfield steam and motor rollers and scarifiers. 20 pages, 6½x3½.

132. "The Austin Western Line." A sixty-four-page catalog has been issued by the Austin-Western Road Machinery Company describing their full line of road building machinery. Included in it are illustrations and descriptions of road graders, 5-foot blade to 12-foot blade; road rollers, steam or gasoline powered, 3 to 15-tons single cylinder to four cylinder. Motor graders, three sizes. Elevating graders, three sizes. Scarifiers. Crushing plant equipment, small road tools, etc.

Special bulletins on each separate piece of machinery supplement the general catalog.

133. The Galion Iron Works and Manufacturing Company of Galion, Ohio. New illustrated bulletins on their Master Four Cylinder Motor Roller, Four Cylinder Tandem Roller, International Motor Roller and International Motor graders.

134. The Russell Grader Mfg. Co., Minneapolis, issues an illustrated catalog of its road equipment, horse and tractor graders, motorized graders, drags, scrapers, gravel equipment, etc. Printed in three colors, 64 pages, 8½x11.

135. The Galion Iron Works & Mfg. Co., of Galion, Ohio. New illustrated bulletins on their master Motor Roller, Three-Wheel and Tandem Rollers, Motor Graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and Straight and Leaning Wheel Graders.

Road Strips

138. Road strips and paving accessories. Also steel buildings, steel ceilings, skylights, ventilators, cornices and many other items illustrated in catalog "G." Saint Paul Corrugating Co., 3-23 West Water St., St. Paul, Minn.

Sand and Gravel Washing Plants

140. Link-Belt Co., Chicago, issues a seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy.

Steam Shovels, Cranes, Excavators

145. The Bay City Dredge Works, Bay City, Mich., issue Catalog 24 and 25, printed in two colors describing one-man operated, convertible gasoline or electric caterpillar mounted shovels for trench excavation and general material handling work.

146. The Insley Mfg. Co., Indianapolis, Ind., issues special booklets on portable gas unit excavators, concrete construction and contractors' equipment.

147. Koehring Company, Milwaukee, Wisconsin. Catalogs giving complete specifications, working dimensions and illustrations on the Koehring No. 301 and 501 gasoline or electric shovels, cranes and draglines.

148. Gasoline or electric locomotive crane, suitable for mounting on crawler, heavy duty trailer, industrial truck, railroad flatcar, portal pier or motor truck (readily transferable from one to another) are featured in Bulletin No. 136-Y offered by the Universal Crane Company, 915 Sweetland Bldg., Cleveland, Ohio.

149. Crawler and Locomotive Cranes, with Grab Bucket, Hook Block, Pile Driver, Magnet, Shovel, etc., are described in catalogs of 28 and 40 pages, issued by Link-Belt Co., Chicago.

Steel Bins

150. Road Building Equipment, Catalog No. 31. Contains complete illustrations and descriptions of Blaw-Knox Measuring Batches, Inundation, Clamshells, Batch Boxes, Steel Bins and Buildings. Address, Blaw-Knox Company, Pittsburgh, Pa.

Steel Forms

155. The Heltzel Steel Form & Iron Company, Warren, Ohio, issue a series of booklets describing Heltzel Curb and Gutter Forms, Steel Road Forms and Sidewalk Forms.

159. Steel Forms or Roads and Streets and Heavy Concrete Construction. The Blaw-Knox Company, Pittsburgh, Pa., have issued a series of handbooks on the subject of steel forms, which cover separately, Road Forms; Street and Sidewalk Forms and Traveling Telescopic Steel Forms. These books are profusely illustrated.

Steel Posts

160. The Sweet's Steel Company of Williamsport, Pennsylvania, have just issued a new catalog describing their line of Herculean Steel Posts, a copy of which will be gladly sent on request.

Steel Towers

165. The Insley Manufacturing Company of Indianapolis describes steel towers and steel masts in connection with chutes for placing concrete, in Catalogs 44 and 45. 95 pages and 16 pages, 8x11.

Tractors

170. "Engine Ingenuity," by the Caterpillar Tractor Co., San Leandro, Calif., and Peoria, Ill., illustrates by actual working photographs the many tough odd jobs done by "Caterpillars" the world over.



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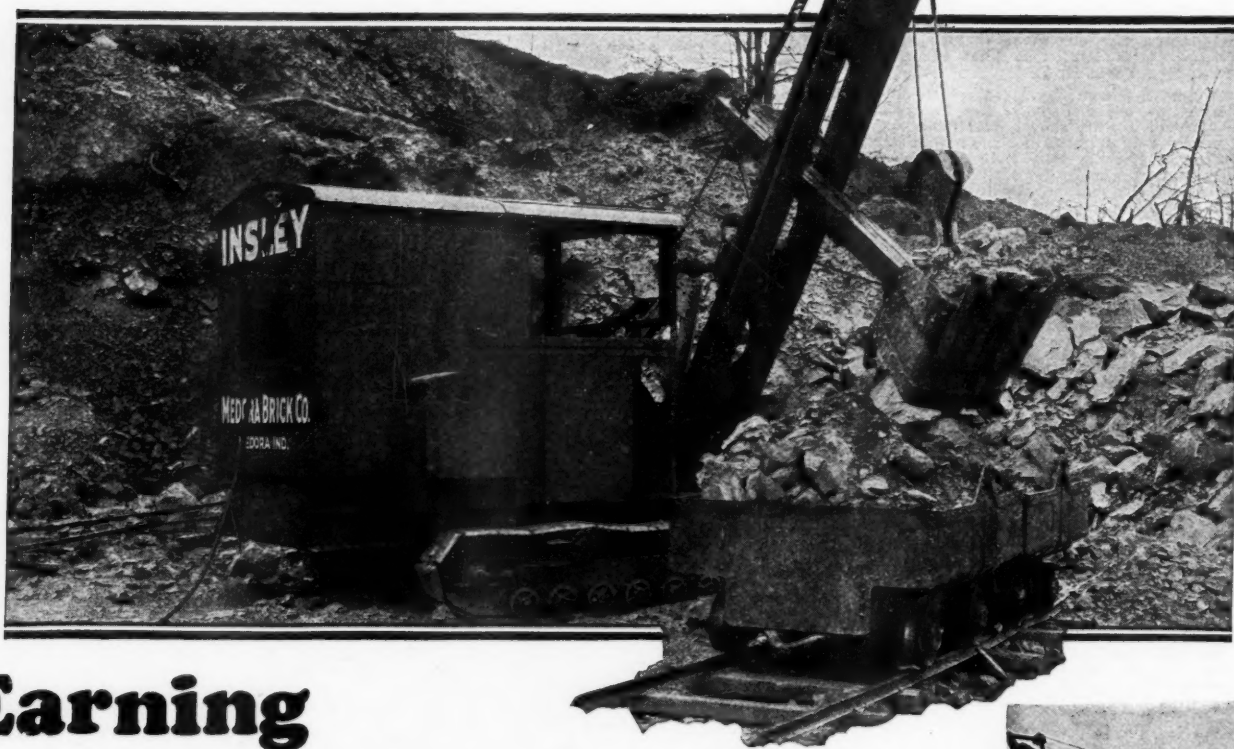



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171. The Caterpillar Tractor Co., San Leandro, Calif., and Peoria, Ill., has recently issued a piece of literature on cutting costs in the quarry.

172. The Huber Mfg. Co., Marion, Ohio, issues bulletins, "Huber Tractors" and "The Huber Scarifier." Illustrations of machines in operation and testimonials from users.

173. "Kerosene Power, the Low-Price Road Builder," bulletin by the International Harvester Co., Chicago, shows economy of kerosene tractors. Illustrations, specifications and figures on cost of operation.

174. "Caterpillar" Power in the Oil Fields, recently published by the Caterpillar Tractor Co., San Leandro, Calif., and Peoria, Ill., tells in 32 pages of beautifully illustrated booklet the story of the new oil industry that is being evolved under the present economic stress.

175. A CLETRAC catalog dealing with road construction and maintenance is now ready for mailing. It covers modern methods of handling large-capacity implements, tandem equipment, etc. The Cleveland Tractor Co., Cleveland, Ohio.

176. "Sure-footed Power for Heavy-duty Work," giving complete information about the Trackson McCormick-Deering Model DH unit, will be sent to contractors, public officials and others by the Trackson Company, 503 Clinton St., Milwaukee, Wis. It describes the uses of this extraordinary power unit and gives illustrations, specifications, etc.

177. Illustrated Pamphlet picturing the Monarch "50" tractors, their construction and specifications, issued by Monarch Tractors Corporation, Springfield, Illinois.

178. Cletrac Crawler Tractors are built in a complete line by The Cleveland Tractor Company, Cleveland, Ohio. Cletracs range in size from the 12 h.p. model to the powerful 100 h.p. tractor.

179. An attractive new circular issued by the Trackson Company, 503 Clinton St., Milwaukee, Wis., describes the practicability and efficiency of Trackson-equipped McCormick-Deering units for road building and maintenance, and also gives action pictures, construction details, and specifications of the Model DH unit.

Truck Cranes

180. Truck Cranes of 5, 6 and 7½ ton lifting capacity full revolving, gasoline or electric powered, for mounting on 5 ton or heavier motor trucks, equipped with clamshell, dragline, pull shovel, backfiller, etc., are described in a 28-page Bulletin No. 136-X offered by the Universal Crane Company, 914 Sweetland Bldg., Cleveland, Ohio.

Truck Hoists

183. "Hoists, Dump Truck." Double the Truck's Value by using power operated Hydraulic Hoists. Catalog of WOOD Hydraulic Hoist and Body Company, Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Waterproofing, Asphalt

190. Proven method for securely bonding asphalt lining to concrete or masonry structures—pipes, basement walls, dams, reservoirs, street surfaces—is described in Bulletin of Asphal-Concrete Corporation, 1440 Broadway, New York City.

Wheelbarrows

195. The Sterling Wheelbarrow Company of Milwaukee describes in their 1928 catalogue wheelbarrows with both wood and tubular

steel handles in various capacities and styles, also barrows of the measuring type and those that conform to the A. G. A. standards. Two-wheeled concrete carts and other allied products are also described. Catalogue is 24 pages, 8½x11 size.

ROAD AND STREET MAINTENANCE

Asphalt, Heaters

200. The Mohawk Asphalt Heater Company, Schenectady, N. Y., presents a New Bulletin describing the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater, for general construction and maintenance. 4 pages, 6½x10.

201. Connery & Company, Inc., of Philadelphia, has issued a new catalog describing improving types of Tar and Asphalt Heating Kettles for the road contractor. 30 pages, 6½x8½.

202. Connery & Company, Inc., of Philadelphia, has issued Bulletin No. P-1 describing Oil Burning Patrol Patching Heater for Paving Contractors, Street and Highway Departments.

203. A 54-page handsome catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates oil, wood and coal burning asphalt and tar, kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools, etc.

Danger Signals

208. McCloskey Torch Company, Spitzer Building, Toledo, Ohio, claim their torches the best danger signal made. Always stay lit, self-righting, unbreakable. Used by highway departments, municipalities, contractors everywhere. Send for circular.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance. It contains tables of composition, grading, etc.

Dust Laying

215. Solvay Sales Corporation, New York, supplies full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost.

Motor Patrols

220. The Russell Grader Mfg. Co., Minneapolis, build four sizes of Motor Patrols—Cletrac 20-K, Caterpillar 2-ton, McCormick-Deering 10-20 and Fordson tractors used for power. Special catalog.

ROAD AND PAVING MATERIALS

Bridges

230. Armo Culvert Mfrs. Association, Middletown, Ohio, has published a 16-page illustrated bulletin "Applying Culvert Simplicity to Highway Bridge Requirements."

Concrete Curing Compound

235. The Dow Chemical Company, Midland, Mich. "How to Cure Concrete" is a "manual of instruction on the curing of concrete pavements." A handy, useful volume, well illustrated. 47 pages, 5½x7½.

236. The Dow Chemical Company, Midland, Mich. "How to Maintain Roads" is a manual of information on road building and maintenance. Contains tables of composition, grading, etc.

237. Illustrated—tells how to cure concrete without dirt and water by the Hunt Process which eliminates glare and hairchecks and makes concrete 8½ per cent stronger. Everlasting Paint and Sales Co., 1110 Board of Trade Bldg., Los Angeles, Calif.

Culverts

245. "Basing Confidence in Culvert Strength on Engineering Facts," a 20-page bulletin describing various culvert strength tests published by Armo Culvert Mfrs. Assn., Middletown, Ohio.

Drainage Pipe

250. A new Rapid Drain Pipe—the entire surface absorbs water, especially efficient for draining highways, sewage disposal plants, parks and reclaiming wet ground. Write for 24-page booklet. Walker Cement Products, Inc., Little Ferry, N. J.

Floor Plates

260. Folder on Central Knobby "Non Skid" Floor Plate. Embossed cover in imitation of piece of plate. Contains seventeen illustrations showing uses of this plate in public buildings, on highways and streets. Central Iron & Steel Company, Harrisburg, Pa.

Maintenance Materials

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control. It contains tables of composition, grading, etc.

272. Preservation of Streets and Roads by the Use of Road Oil, with many illustrations and testimonials from users. The Standard Oil Co., of Indiana, Chicago.

273. Stanolind Paving Asphalt, a compound prepared by the Standard Oil Co. of Ind., is described in minute detail in booklet "Stanolind." Standard Oil Co. of Indiana, Chicago.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with "Tarvia K-P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. 56 pages, illustrated, 6x9. The Barrett Company, New York.

277. "Tarvia." An attractively illustrated booklet describing grades of Tarvia and showing photographs of actual applications. 32 pages, 6-9. The Barrett Company, 40 Rector Street, New York City.

GARBAGE DISPOSAL

300. The Sterling Garbage Destructor, a booklet recently published by the C. O. Bartlett & Snow Company, Cleveland, Ohio, describes the operation of the Sterling furnace and a typical installation, and illustrates plants in leading cities.

301. Balmer Incinerators are described and their advantages discussed in a booklet which may be obtained from the Shevlin Engineering Co., Inc., 227 Fulton Street, New York.

305. "United States Standard Incinerator" built and guaranteed by the Pittsburgh-Des Moines Steel Company, 679 Professional Building, Pittsburgh, Pa., is described fully in a booklet sent on request.

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The Fastest Melting Oil Burning Heater Made

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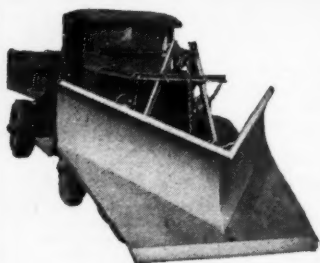
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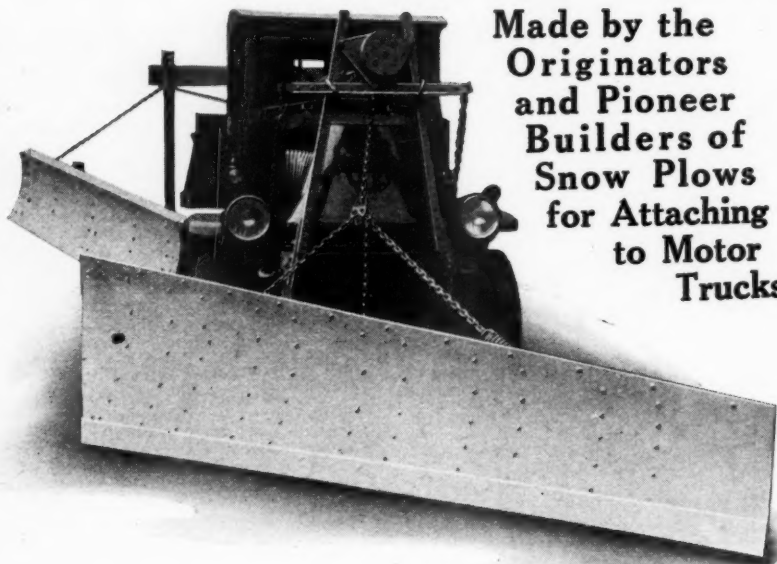


Model 24—Size No. 1. For
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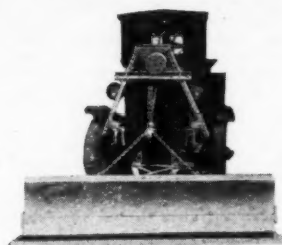
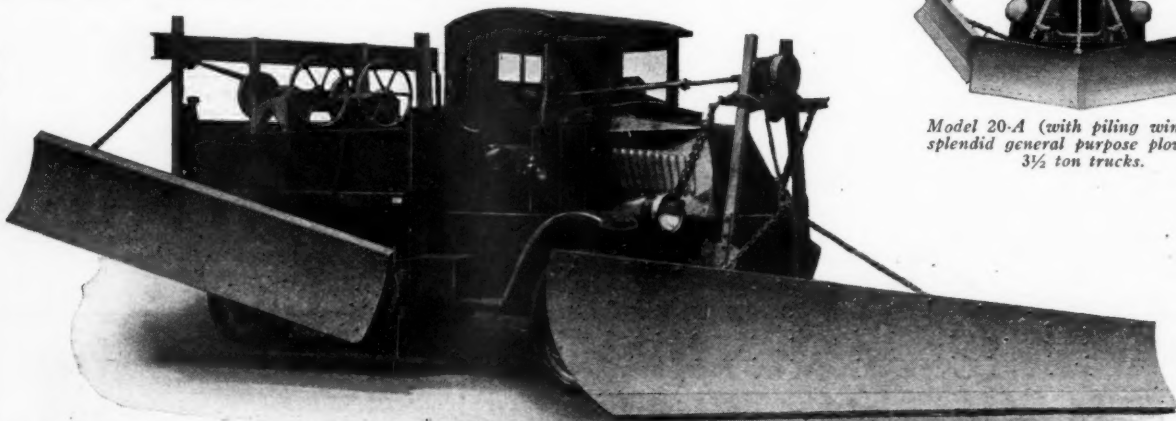


CHAMPION SNOW PLOWS

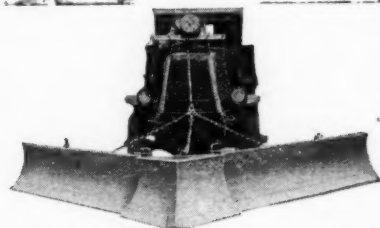
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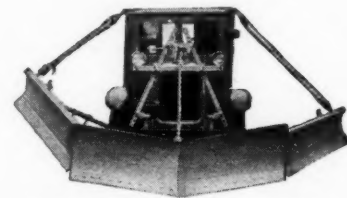
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2 to 5 ton trucks.
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Model 21-B—High-Speed Plow. Max.
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Model 20-A—For bus and transpor-
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Model 20-A (with piling wings)—A
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Many other
models—not
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STREET CLEANING AND SNOW REMOVAL

Snow Removal

350. The W. A. Riddell Co., successors to Hadfield-Penfield Steel Co., Bucyrus, Ohio, has just issued new circulars describing Fordson Snow Removers and Hadfield-Penfield One-Man Graders.

351. Universal Crane Company issues Bulletin 34 devoted entirely to "Snow Removal and Winter Work." Action photographs, illustrations and construction details. Universal Crane Company, Swetland Bldg., Cleveland, Ohio.

352. Walter Motor Truck Co., Long Island City, New York, has issued two 4-page leaflets telling the advantages of the "Walter Snow Fighter" and a 16-page pamphlet describing its construction and the uses to which the chassis can be put, such as to carry a street flusher, garbage body, oil distributor, etc.

353. A CLETRAC folder showing efficient methods of quickly combating the snow menace on highways and city thoroughfares. Illustrates joint use of crawler tractors and standard and special snow plows. The Cleveland Tractor Co., Cleveland, Ohio.

354. "Snow Removal 1928 Edition," just off press of the Caterpillar Tractor Co., is the annual handbook for road and street engineers in the snow belt. Its 66 pages are illustrated with pictures showing the actual removal of snow in all sections of the country annually blanketed. All the new methods are shown for better, quicker, cheaper handling of this problem.

355. "Snow-free roads pay direct returns to every community in health, safety, and prosperity" is the subject of an interesting article on snow removal in the Model DH Trackson McCormick-Deering folder issued by the Trackson Company, 503 Clinton St., Milwaukee, Wis. It will be sent on request.

356. Catalog 1027 on Snow Removal gives specification details, illustrations, cost analysis for removing snow and comparison of operating expenses. Issued by George Haiss Mfg. Co., 139th Street and Rider Avenue, New York City.

357. Catalog No. 27 giving descriptions and illustrations of the Frink "Sno-Plows," which are adaptable to any truck or tractor. Published by Carl H. Frink, Clayton, N. Y.

358. 20 models of the Baker "Time-tried" snow plows are described in a large catalog containing prices and illustrations. Prepared by Baker Mfg. Co., 525 Stanford ave., Springfield, Ill.

359. Galion Iron Works and Mfg. Co., Galion, Ohio, will gladly furnish details, prices or catalogs of their snow plow adaptable to any make of truck.

Sweepers

360. Catalogue No. 4 issued by the Kinney Mfg. Co., Boston, Mass., gives complete information on the sturdy construction and simplicity of operation of the Kinney-Springfield Motor Sweeper, supplemented by numerous illustrations.

SEWAGE AND SEWAGE DISPOSAL

Inlets and Manhole Covers

400. Cast iron sewer blocks, ventilators, manhole covers and inlets, valves, etc., described in pamphlet by the South Bend Foundry Co., South Bend, Ind.

401. Adjustable manhole tops, valve and other roadway boxes, and cast iron sectional manholes for sewer, water and electric service are described in literature issued by S. E. T. Valve & Hydrant Co., 50 Church St., N. Y.

Pipe, Vitrified

405. The Progressive Clay Co., offices in New York City, Philadelphia, Pa., and Syracuse, N. Y., furnish full information regarding Vitrified Pipe and other heavy clay products. Illustrated price list on application. Factories in Pennsylvania and Ohio.

Pumps

407. "Sewage Pump Installations" showing installations in reproductions from photographs of jobs of "American" centrifugal sewage pumps. Bulletin No. 193. American Well Works, Aurora, Ill.

408. Fairbanks, Morse & Co., Chicago, Ill. Bulletin H341A, "Sewage and Trash Pumps," covering pumps designed to handle fluids containing large solids; also describing automatic sewage relief stations.

Screens

409. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6731, which describes the construction and operation of the mechanically cleaned Dorrco Bar Screen.

Septic Tanks

410. San-Equip Septic Tanks for homes, institutions, etc., not reached by sewers, are described and illustrated in data sheets and handbook on sewage treatment issued by Chemical Toilet Corporation, Syracuse, N. Y.

411. Septic Tanks made of Copper-Bearing, Rust-Resisting Iron—all seams extra heavy welded, are described and illustrated in a folder published by the manufacturers, Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Sewer Joint Compound

415. The RUBEROID Co., 95 Madison Ave., New York, issues folder on Bituminous Jointing Compound; proof against infiltration and root penetration.

Sludge Bed Enclosures

420. "Glass-Steel" enclosures for drying sludge. Heavy weight all-steel and glass construction, using hot galvanized rolled steel glazing bars and sash. Barns Engineering Co., Inc., 155 East 42nd Street, New York City.

Treatment

425. Dorr Company, 247 Park Avenue, New York, in its Sanitary Engineering bulletin describes the use of its equipment for treating municipal sewage, industrial wastes and water. Photos of numerous operating plants are shown as well as representative flow sheets illustrating the various methods of sewage treatment.

426. Link-Belt Company, Philadelphia, issues a book describing the Tank Sewage Screen for separation of solids from incoming sewage—a construction furnishing maximum fine screening capacity, in a minimum space, at minimum cost.

427. The Pacific Flush Tank Company, of Chicago and New York, publish eight separate catalogs on Sewer and Sewage Disposal Automatic Equipment, including pumps, Imhoff Tanks and Sewer Joint Compounds.

428. Advantages of Liquid Chlorine for disinfection given in booklet issued by the Electro Bleaching Gas Co., 9 East 41st St., New York.

429. Chlorine is being extensively used in the disinfection of sewage, not only as a disinfectant but as an aid to other purification

processes. Wallace & Tiernan Co., Inc., Newark, N. J., have a bulletin, No. 42, on the chlorination of sewage which will be sent to any address on request.

430. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6171, which describes the Dorr Traction Clarifier, an improved type of continuous sedimentation for use in water and sewage treatment plants.

431. Shevlin Engineering Co., Inc., 227 Fulton St., New York, publishes a bulletin which describes the improved Runsch-Wurl type screen for economical sewage treatment.

WATER WORKS EQUIPMENT

Diesel Engines

490. Fairbanks, Morse & Co., Chicago, Ill. Bulletin 4301, "Diesel Power Units for Mobile and Stationary Plants," describing self-contained power plants for driving construction machinery or for stationary plants where small space is available.

Gates

500. Sluice Gates of all kinds, Roller Bearing Pedestals, Hoisting Standards, Intake Gates, Plug Drain Valves and other Water Works Appliances described in catalog by Coldwell-Wilcox Company, Newburg, N. Y.

Hydrants

505. R. D. Wood & Co., Philadelphia, Handy circular describing and illustrating "Mathews" Fire Hydrants, Gate Valves and other water works appurtenances. 16 pages, 7 3/4 x 10 3/4.

506. Hydrants, tapping apparatus, gate locks valves and curb cocks described in a series of bulletins issued by the A. P. Smith Mfg. Company, East Orange, N. J.

507. "Newtype" Hydrants and Water Gates are described in a bulletin issued by the Kennedy Valve Mfg. Co., Elmira, N. Y. Bulletin contains diagrams and complete specifications.

508. "The Popular Vogt" adjustable, revolving head Fire Hydrants, hub and tapping valves, sleeves, valve boxes, etc. Details obtainable from Vogt Bros. Mfg. Co., Inc., Louisville, Ky.

Meters

510. Booklet describing the improved frost bottom meter, with the Spiral Gear Train. Manufactured by Phoenix Meter Company, Princess Bay, New York. 8 pages, 6x9.

511. "Watch Dog" Current Meters for every need manufactured by the Gamon Meter Company, 282 South Street, Newark, N. J. Catalog of illustrations, 19 pages, 7x10.

512. The Buffalo Meter Company, Buffalo, issues a very complete catalog describing Niagara and American disc water meters. These meters are made with either solid type casing or frost bottom casing.

513. The Buffalo Meter Company, Buffalo, issues a special catalog describing Niagara Oil and Gasoline Meters, which explains the methods of installing and operating these meters.

515. Hersey Torrent Meters, for measuring large volumes of water with comparatively small loss of head, such as services to railway standpipes, hydraulic elevators, etc. Hersey Manufacturing Company, South Boston, Mass. Illustrated catalog.

516. Hersey Compound Water Meter, accurately measures a wide range of flow. Hersey Manufacturing Company, South Boston, Mass. Illustrated catalog.



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517. Hersey Detector Meter, the original fire service meter, accurately measures small rates of flow and in case of necessity, delivers and measures large volumes without obstruction or loss of head. Hersey Manufacturing Company, South Boston, Mass. Illustrated catalog.

518. Hersey Disc Water Meters, for use on all services where extreme reliability and durability are required—a revenue computer of the highest quality. Hersey Manufacturing Company, South Boston, Mass. Illustrated catalog.

Meter Boxes

525. Efficient installation and maintenance of water meters is described in catalogue issued by H. W. Clark Company, Mattoon, Ill., manufacturers of Meter Boxes, Coupling Yokes, Meter Testers, Service and Valve Boxes.

Meter Setting and Testing Equipment

530. Catalog, Ford Meter Setting and Testing Equipment, Ford Meter Box Covers, Single and Double Lid; Ford Yokes, Ram's Horns and Ford Meter Testers fully illustrated and described. Forty-eight pages, 6x9.

Pipe, Cast Iron

535. The McWane Cast Iron Pipe Co., Birmingham, Ala., issues Catalog P, describing Cast Iron Pipe, sizes 1 1/4 through 8 inches, equipped with factory-made Precalced lead joints in the bells.

536. R. D. Wood & Co., Philadelphia, issues a new booklet giving weights and dimensions of Cast Iron Pipe and Fittings. A handy reference book for Municipalities and Contractors. 48 pages, 7 1/4 x 10 3/4.

537. "Universal Cast Iron Pipe" for water supply, fire protection and sewage disposal. All jointing materials eliminated. Machined iron-to-iron joints made with wrenches only. (Booklet) The Central Foundry Co., 420 Lexington Avenue, New York, N. Y.

538. High Pressure Fire Protection Lines. Booklet containing excerpts from Underwriters report on Universal Cast Iron Pipe. The Central Foundry Company, 420 Lexington Avenue, New York, N. Y.

539. U. S. Cast Iron Pipe Handbook contains useful tables and data for the Water Works man on pipe line construction. Issued by U. S. Cast Iron Pipe and Foundry Company, Burlington, N. J.

Pipe, Cement Lined

540. Steel or Wrought Iron Pipe lined with cement and special lead-lined joints, manufactured by the Cement Lined Pipe Co., of Lynn, Mass.

541. Charles W. Shermans paper contains description of process, specifications for lining and results of tests on material. Booklet on request. U. S. Cast Iron Pipe & Foundry Company, Burlington, N. J.

Pipe, Concrete

545. "The Story of Tulsa's Spavinaw Project," "Bringing 'C' Up to 140 Plus," and General Catalogs on Lock Joint Reinforced Concrete Pressure and Sewer Pipes. Lock Joint Pipe Co., 16 Rutledge Ave., Ampere, N. J.

546. Details and estimates will be gladly submitted on request for Reinforced Concrete Pipe requirements for sewers, waterworks, culvert and subaqueous lines. Newark Concrete Pipe Co., 462 Broad Street, Newark, N. J.

547. Low and high pressure concrete pipe made by Moir-Buchanan machines, with output, description of process and tests covered in Bulletin No. 3 of Asphalco-Concrete Corporation, 1440 Broadway, N. Y.

548. Standard specifications for sand cast, cast iron pipe, according to the American Water Works Association Specifications; deLavaud centrifugally cast, cast iron pipe, according to the deLavaud specifications; special castings. National Cast Iron Pipe Co., Box 2542, Birmingham, Alabama.

Pipe Covering

550. The Philip Carey Company, Cincinnati, Ohio, presents material on Carey Asbestos Pipe Line Felt, durable, corrosion-proof armor to protect pipe lines against water and alkali soils. Complete description and specifications.

Pipe Jointing Materials

560. Leadite as an economical composition for pipe joints described in a bulletin by the Leadite Company, Land Title Building, Philadelphia, Pa.

Pumps

565. The Kinney Mfg. Company, Boston, will send a folder of bulletins on Rotating Plunger Pumps, Unloading Pumps, also tables of information for water works calculations.

566. The Edison Manufacturing Corporation, Boston, describes its improved designs in diaphragm pumps, both hand and power; odorless force pumps, and suction hose for the same and other pump accessories. 9 pages, 8 1/2 x 11.

Pumping

568. "Type U Pumps" showing the new solid shell, single suction type of centrifugal pump. Bulletin No. 198. American Well Works, Aurora, Ill.

569. "Two Stroke Totally Enclosed Power Heads," describing late developments of the "American" enclosed automatically lubricated Deep Well Power Pump Heads for municipalities, industries, etc. Bulletin No. 199. American Well Works, Aurora, Ill.

570. Fairbanks, Morse & Co., Chicago, Ill. Bulletin H311, "Fig. 800 Centrifugal Pumps," illustrating electrically driven pumping units for public waterworks systems and general pumping.

Pump Packing

573. The Philip Carey Company, Cincinnati, Ohio, present descriptive literature on Carey Pump Packing, used on steam pumps to prevent leakage. Withstands high temperatures—steam and water will not injure it.

Pumping Engines

575. "When Power Is Down," by the Sterling Engine Company, Buffalo, N. Y., gives illustrations from various cities of Sterling Pumping Engines in use, with recommendations of models for standby services.

576. Fairbanks, Morse & Co., Chicago, Ill. Bulletin 1060, "Municipal Power Plant Developments," illustrating, describing and giving cost data on Diesel engine operated lighting and water-supply systems.

Service Boxes

578. "Service Boxes with Stay-on Covers. No more broken covers. No more lost covers." (Booklet) The Central Foundry Company, 420 Lexington Avenue, New York, N. Y.

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580. Wallace & Tiernan Co., Inc., Newark, N. J., have just published a new edition of technical publication, No. 41, dealing with the sterilization of swimming pools by liquid chlorine. Copy sent on request.

581. Wallace & Tiernan Co., Inc., Newark, N. J., have just issued technical publication No. 43 on the W. & T. Chloro Boat—a boat equipped with chlorinating equipment to sterilize bathing areas, small lakes, ponds, etc. Copy sent on request.

Tapping and Valve Machines

583. The A. P. Smith Company, of East Orange, N. J., furnish descriptive matter dealing with their many labor saving devices as the Smith tapping machine, valve inserting machine and pipe cutting machines.

Turbines

584. "Deep Well Turbines" describing the "American" Deep Well Turbine Pumps, motor and belt drive. Bulletin No. 196. American Well Works, Aurora, Ill.

Valves

585. A complete catalogue of more than 210 pages containing descriptions, illustrations, specifications and price list of valves, water-gates and hydrants for every purpose, mailed on request. Kennedy Valve Mfg. Co., Elmira, N. Y.

586. Ross Valve Mfg. Co., Inc., Troy, N. Y. —Automatic Pressure Control & Standpipe Valves, for Water, Fire Depts. and Industrial Plants, briefly described in Catalogue No. 27.

Water Purification

590. Chlorine and Salts for purification of water and disinfection of sewage with description of Pennsylvania Salt Manufacturing Company's facilities for supplying these cheaply. Booklet, 15 pages, 3 1/2 x 6. Widener Building, Philadelphia.

591. Wallace & Tiernan Co., Inc., Newark, N. J., have just published a new technical publication, No. 74, describing chlorine control apparatus for the sterilization of the water supplies of small communities. Copy will be sent on request.

Water Works Supplies

596. A 50 page catalog issued by Pittsburgh Des Moines Steel Co., Professional Bldg., Pittsburgh, Pa., on complete water works plants, elevated tanks, stand pipes and filtration plants built by them.

MISCELLANEOUS

Airports

600. "We Need More Airports—Lindy" is the title of a cleverly illustrated broadside on the problem of building airports with speed and at low cost by the use of "Catterpillar" Tractors. It is a new piece of literature from the Caterpillar Tractor Co., San Leandro, Calif., and Peoria, Ill.

Asphalt Paints

605. Asphalt Paints for all purposes are described in attractive folders issued by The RUBEROID Co., 95 Madison Ave., New York.

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610. Machine made, round or rectangular conduits with multiple ducts for telephone, telegraph, electric power cables—watertight, tough, easily joined—are covered in Bulletin of Asphalco-Concrete Corporation, 1440 Broadway, N. Y.

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Magnetos

620. The Eismann Magneto Corporation, 165 Broadway, New York City, issues individual instruction booklets, covering different models. Also supplies Directory of Official Service Stations on request.

Protective Coatings

623. "Safeguarding Pipe Lines and Exposed Metal Surfaces"—illustrated—describes protective coatings that have successfully withstood worst forms of corrosion and electrolysis. Everlasting Paint and Sales Co., 1110 Board of Trade Bldg., Los Angeles, Calif.

Rules

625. The Lufkin Rule Company, Saginaw, Mich.; New York; Windsor, Canada. Manufacturers of Measuring Tapes, Boxwood Rules, Spring Joint Rules, Straight and Folding Steel Rules, Fine Mechanics' Tools. General catalog No. 11.

Surveying Instruments

640. Kern Company, 136 Liberty Street, New York City, offers a folder PJ-1 which gives an outline of Kern Surveying Instruments, comprising Theodolites, Transits, Leveling Instruments, Plane Table Equipment, and auxiliary instruments. For Universal Instruments and Astronomic Instruments, ask for special literature.

Termites and dry-rot

630. "An Advancing Army That Threatens Our Homes"—profusely illustrated—describes method absolute prevention of damage by termites (white ants) and dry-rot. Everlasting Paint and Sales Co., 1110 Board of Trade Bldg., Los Angeles, Calif.

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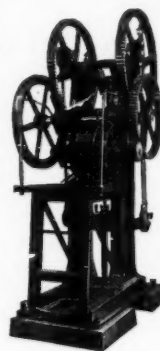
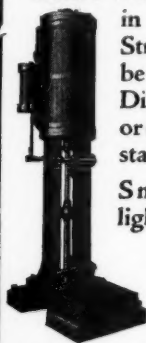
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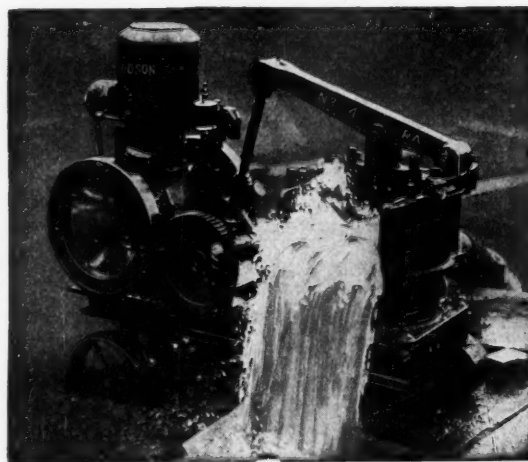
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